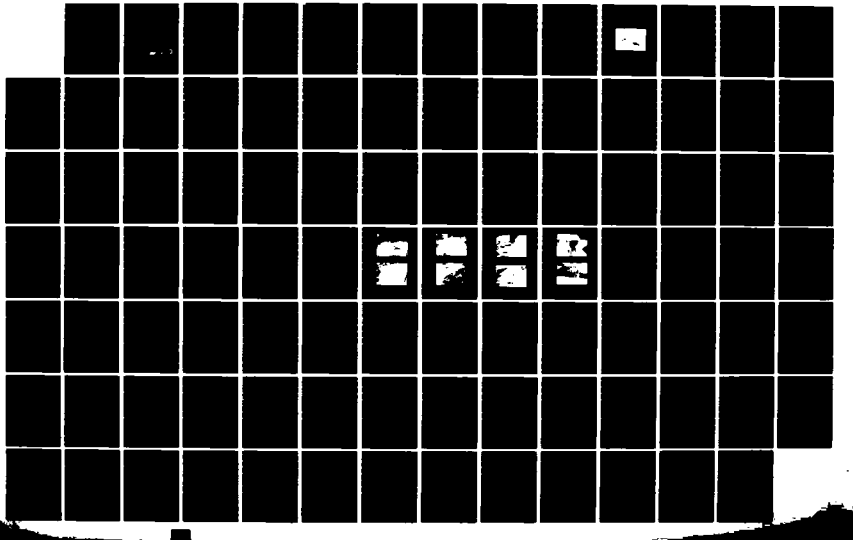
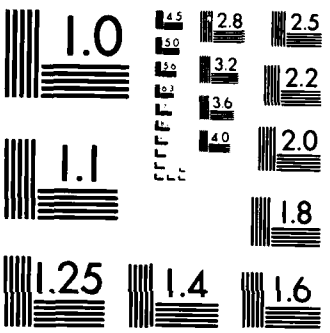
AD-A156 319 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS LAKE ANASAGUNTICOOK D.. (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV NOV 79 1/1

UNCLASSIFIED F/G 13/13 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

ANDROSCOGGIN RIVER BASIN

CANTON, MAINE

AD-A156 319

LAKE ANASAGUNTICOOK DAM

ME 00434

STATE NO. 0176

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

NOVEMBER 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ME 00434	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Lake Anasagunticook Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE November 1979 13. NUMBER OF PAGES 45
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Androscoggin River Basin
Canton, Maine
Whitney Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam has a hydraulic height of 20 ft. and a total length of 175 ft. The dam is in poor condition and there are major concerns which should be corrected to assure the continued performance of the dam. It is intermediate in size with a hazard potential of significant.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

JUL 07 1980

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

Inclosed is a copy of the Lake Anasagunticook Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Agriculture cooperating agency for the State of Maine. In addition, a copy of the report has also been furnished the owner, Brindis Leather Company, Haverhill, Massachusetts.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you, the Department of Agriculture for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	ME00434
Name of Dam:	Lake Anasagunticook Dam
Town:	Canton
County and State:	Oxford County, Maine
Stream:	Whitney Brook
Date of Inspection:	September 18, 1979

BRIEF ASSESSMENT

Lake Anasagunticook Dam has a hydraulic height of 20 feet and a total length of 175 feet. It consists of a concrete gated spillway structure, 25 feet in length, and a 150-foot long earthen emb nkment. The average width across the crest of the earthen embankment is 25 feet. Four wooden rectangular, vertical lift gates, 6.4' H x 4.5' W, span across the entire length of the spillway and serve to regulate the lake level. The dam spans the headwaters of Whitney Brook and is located in southwestern Maine. The drainage area above the dam is 14.95 square miles. Maximum storage capacity is about 5,800 acre-feet. Normal pool is approximately 11,500 feet long and has a surface area of about 582 acres. Lake Anasagunticook is used for recreational purposes.

The dam is in poor condition. Major concerns are: a sinkhole in the earth embankment; the deteriorated condition of the stone-masonry retaining wall at the downstream edge of the embankment; trespassing on the crest and downstream slope of the embankment near the west abutment; deterioration of the concrete in the gated spillway structure; rusting of the steel gate slots and steel members of the service bridge; deterioration of the wooden planking of the service bridge; leakage of undetermined origin at the contact between bedrock and a concrete building foundation wall on the west bank of the downstream channel; the growth of brush on the upstream slope and downstream toe of the embankment; inoperability of 2 gates; and the inability of the spillway to pass a significant amount of the test flood.

Based on intermediate size and significant hazard classification in accordance with Corps guidelines, the test flood ranges from ½ to the Probable Maximum Flood (PMF). Because there would be a small potential, if any, for loss of life in event of a breach and the dam's size is in the lower range of the intermediate classification, the ½ PMF was selected as the test flood. The test flood inflow is 11,438 cfs (765 csm) and would result in a test flood outflow of 9,900 cfs (660 csm). The test flood outflow of 9,900 cfs at elevation 408.0' MSL would overtop the dam by 3.8 feet. The spillway, with the gates closed, will pass 180 cfs or about 1.8% of the test flood outflow. A major breach at top of dam could result in appreciable property damage to residential and commercial structures located along State Route 140, with possible loss of a few lives.

The owner, Brindis Leather Company, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan
Project Manager
N.H. P.E. 2339

This Phase I Inspection Report on Lake Anasagunticook Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

Accession For	
NTIS GRA&I	X
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A/1	

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

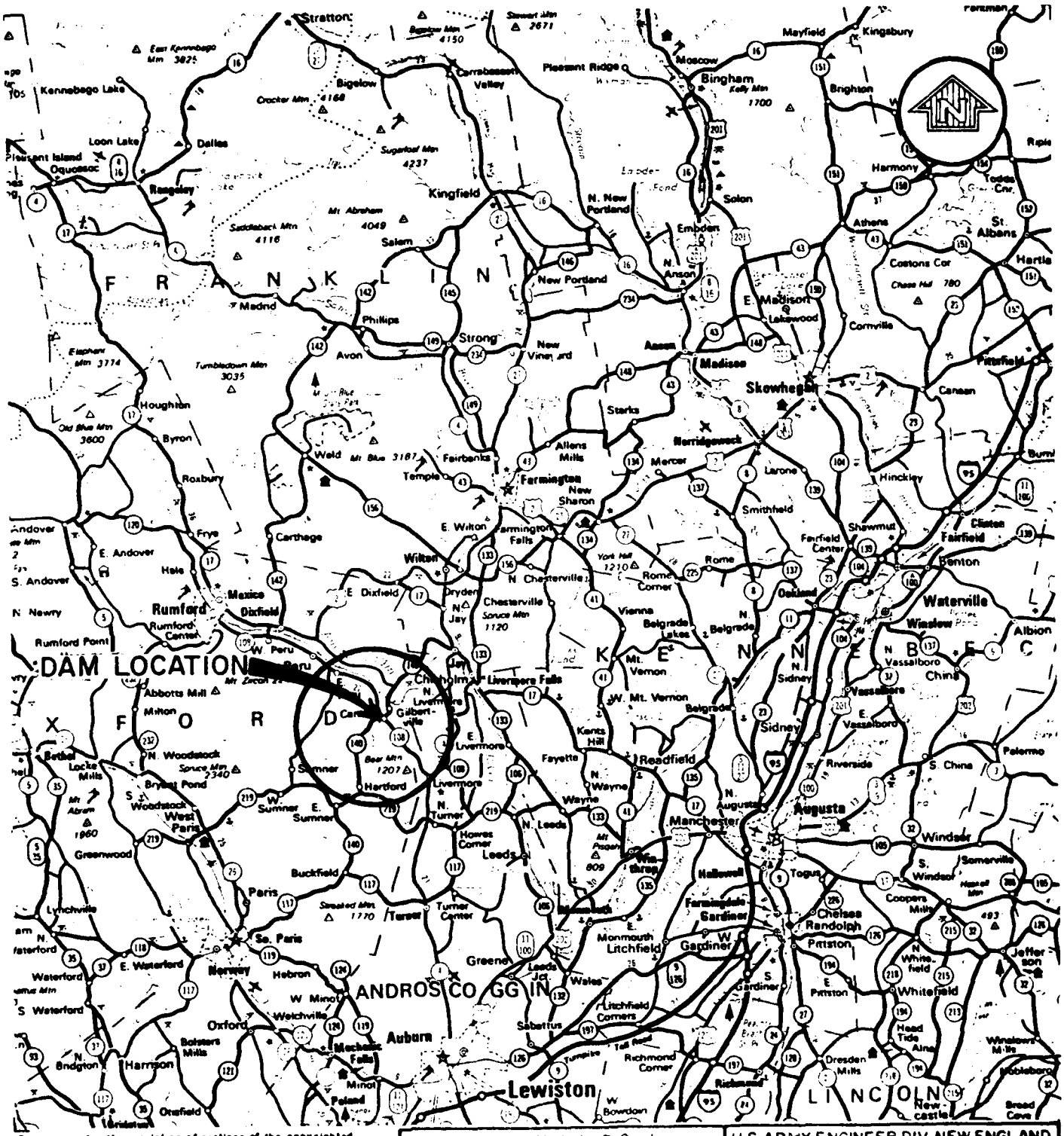
Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

REPORT

APPENDICES

October 1979
Figure 1 - Overview of Lake Anasagunticook Dam.



Permission for the reprinting of sections of the copyrighted State of Maine map has been obtained in writing from the Maine Department of Transportation. 9/16/78

SCALE IN MILES

0 10 20

MAP BASED ON 1979-1980 OFFICIAL TRANSPORTATION MAP, STATE OF MAINE

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE ANASAGUNTICOOK DAM LOCATION MAP

WHITNEY BROOK MAINE

			SCALE: SEE BAR SCALE
			DATE: NOVEMBER 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
LAKE ANASAGUNTICOOK DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Maine. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of March 16, 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050, as changed, has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Lake Anasagunticook Dam is located in the Town of Canton, Maine. The dam consists of a concrete, gated spillway section and an earthen embankment which spans the headwaters of Whitney Brook, approximately 2.1 miles upstream of its confluence with the Androscoggin River. The dam is shown on the U.S.G.S. Quadrangle, Canton, Maine, with coordinates approximately at N 44° 26' 24", W 71° 19' 00", Oxford County, Maine. (See Location Map page vii.)

b. Description of the Dam and Appurtenances. Lake Anasagunticook Dam is a low dam (hydraulic height 20 feet) which totals 175 feet in length. The dam consists of 25 feet of concrete-gated spillway section and a 150-foot long earthen embankment. The concrete-gated spillway section consists of 4 wooden gates, each 6.4' H x 4.5' W, separated by 3 equally spaced 18-inch wide concrete piers which extend 13 feet parallel to the stream flow. A fourth 18-inch concrete pier separates the most eastern gate opening and an intake bay located immediately beneath an abandoned building located on the east abutment of the dam. The intake bay has been closed off with wooden planks. A steel service bridge with a wooden deck spans the concrete spillway and extends 25 feet from the east abutment of the dam to the earthen embankment which originates at the west edge of the concrete spillway structure. The service bridge, supported by the four concrete piers located at the spillway section, is 13 feet in width. An earthen embankment extends 150 feet in the southwesterly direction from the west end of the concrete spillway section to the west abutment. The crest of the earth embankment averages approximately 25 feet in width. A stone masonry retaining wall is located on the downstream edge of the embankment and its height varies from approximately 12 feet near the junction with the concrete spillway section to 0 feet where the embankment joins the west abutment. Concrete training walls are located on both sides of the approach channel to the spillway structure. An 18-foot wide concrete spillway apron with two concrete retaining walls is located immediately downstream of the gates. The concrete apron has a slope of 25% for a length of 24 feet.

c. Size Classification. Intermediate (hydraulic height - 20 feet; storage - 5,800 acre-feet) based on storage ($\geq$ 1,000-$<$50,000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant Hazard. A major breach of the earthen embankment which forms the southwest portion of the dam could result in the possible loss of a few lives and appreciable property damage. (See Section 5.1 f.)

e. Ownership. Lake Anasagunticook Dam is presently owned by Brindis Leather Company of Haverhill, Massachusetts. George Brindis of Brindis Leather Company indicated that ownership of the dam was acquired in 1956 from Armour and Company. Mr. Brindis also provided, according to his recollection, a chronological list of previous owners, beginning with the most recent owner: Brindis Leather Company, Armour and Company, Winslow Brothers and Smith Company, Lyman D. Smith Company. Dates indicating the exact period of ownership were not disclosed.

f. Operator. The current operator of the Lake Anasagunticook Dam is the Town of Canton, Maine, Town Hall, Canton, Maine 04221. Phone: (207) 597-3661. The agreement granting the town regulatory authority can be seen in Appendix B.

g. Purpose of Dam. The purpose of the original construction of Lake Anasagunticook Dam is not known. Brindis Leather Company utilized the dam to supply industrial process water for its tannery operations from its date of acquisition in 1956 to September, 1976, when the tannery ceased operation. It is believed that previous owners utilized the dam for similar purposes. George Brindis of Brindis Leather Company understood that the dam was utilized for power generation at some time prior to 1956. Lake Anasagunticook Dam is presently used to regulate the lake level for recreational purposes.

h. Design and Construction History. The original construction date of Lake Anasagunticook Dam is not known. No information regarding the original design and construction of the dam was disclosed. George Brindis of Brindis Leather Company stated that his company had some repair work done to the dam approximately 10-15 years ago. He indicated that the repair work concentrated on the concrete piers and the gate works of the spillway.

i. Normal Operating Procedures. No written operating procedures were revealed. Operating rights were acquired by the Town of Canton in December, 1978, from Brindis Leather Company. Presently the Fire Chief of the Town, Donald Noyes, operates the gates, as deemed necessary, under the supervision of the Town's Board of Selectmen.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 14.95 square miles (9,570 acres) of rolling to mountainous terrain. The normal pool has a surface area of 582 acres which constitutes 6 percent of the watershed.

b. Discharge at Dam Site

(1) Outlet works - none

(2) Maximum discharge at damsite - unknown

(3) Ungated spillway capacity at top of dam elevation - not applicable

(4) Ungated spillway capacity at test flood elevation - not applicable

(5) Gated spillway capacity @ top of dam elevation - 180 cfs @ 404.2' MSL (assuming gates closed) - 1,803 cfs @ 404.2' MSL (gates fully opened)

(6) Gated spillway capacity @ test flood elevation - 972 cfs @ 408.0' MSL (assuming gates closed)

(7) Total spillway capacity @ test flood elevation - 972 cfs @ 408.0' MSL (assuming gates closed)

(8) Total project discharge @ test flood elevation - 9,900 cfs @ 408.0' MSL

c. Elevation (feet above NGVD of 1929; formerly called Mean Sea Level (MSL); see (6) below.)

(1) Streambed at centerline of dam - 384 (downstream toe)

(2) Maximum tailwater - unknown

(3) Upstream portal - (power intake invert = 395.6', presently opening is blocked)

(4) Recreation pool - 402.0

(5) Full flood control pool - not applicable

(6) Spillway crest (top of gates) - 402.0 (shown on U.S.G.S. Quadrangle Sheet and assumed to be spillway crest)

Gate invert - 395.6

(7) Design surcharge - unknown

(8) Top of dam - 404.2

(9) Test flood pool - 408.0

d. Reservoir (feet)

(1) Length of maximum pool - 11,700 feet

(2) Length of recreation pool - 11,500 feet

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - 4,924

(2) Flood control pool - not applicable

(3) Spillway crest pool - 4,924

(4) Top of dam - 5,800

(5) Test flood pool - 7,475

f. Reservoir Surface (acres)

(1) Recreation pool - 582

(2) Flood control pool - not applicable

(3) Spillway crest - 582

(4) Test flood pool - 685

(5) Top of dam - 618

g. Dam.

(1) Type - earthen embankment with concrete-gated spillway section

(2) Length - 175"

(3) Height - 22' (structural)

(4) Top width - averages 25' (earth embankment)

(5) Side slopes - Downstream face of earth embankment is vertical stone-masonry wall. Upstream face of embankment is inclined at 1½H:1V.

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway

(1) Type - concrete

(2) Length of weir - 18'

(3) Crest elevation - 402' MSL

(4) Gates - 4 wooden gates - 4.5' W x 6.4' H
1 power intake bay - unknown size (under building; presently blocked)

(5) U/S Channel - Lake Anasagunticook is a recreational lake with residential structures located on portions of its banks. A wood deck walkway supported by three concrete piers is located approximately 200 feet upstream of the spillway.

(6) D/S Channel - Whitney Brook originates at the outlet of Lake Anasagunticook. The channel immediately downstream of the dam is narrow with steep vertical stone masonry walls and has a rock and boulder covered bottom. Located approximately 75 feet downstream of the spillway is an enclosed wooden walkway which connects two abandoned buildings situated on opposite banks of the brook. The downstream channel remains narrow with steep banks for a length of approximately 1,200 feet downstream of the spillway. In this reach of Whitney Brook are located two state routes (Route 108 and Route 140) and one town road bridge crossing. Whitney Brook flows for a length of approximately 2.1 miles from the dam before discharging into the Androscoggin River.

j. Regulating Outlets. None.

SECTION 2
ENGINEERING DATA

2.1 Design

No original design data was obtained for Lake Anasagunticook Dam.

2.2 Construction Records

No written construction records were disclosed. The owner stated that some repair work was done to the gate structure approximately 10 - 15 years ago.

2.3 Operation

No engineering operational data were obtained.

2.4 Evaluation

a. Availability. Direct contact with the owner, the operator (Town of Canton, Maine), and a search of the files of the Maine Soil and Water Conservation Commission revealed only a limited amount of oral recorded information.

b. Adequacy. The final assessments and recommendations of this investigation are based on the visual inspection and the hydrologic and hydraulic calculations.

c. Validity. No engineering data were disclosed to validate.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Lake Anasagunticook Dam is a low dam which impounds a reservoir of intermediate size. The watershed above the reservoir is rolling and partially wooded. The downstream area is flat.

b. Dam. Lake Anasagunticook Dam is an earthen embankment about 20 feet high (hydraulic height), 175 feet long, and averages 25 feet in width across the crest, with a concrete gated spillway structure near the east abutment.

The crest of the embankment is covered with grass. (See Appendix C - Figure 2.) A small sinkhole, about 1½ feet wide and 6 inches deep was found in the crest of the embankment about 10 feet to the west of the gated spillway structure and about 2 feet from the downstream edge of the crest. (See Appendix C - Figure 3.)

A concrete training wall is located at the upstream edge of the crest of the embankment (which is also the west bank of the approach channel to the spillway) extending upstream for a distance of 47 feet from the gated spillway structure. From the end of this training wall to the west abutment of the dam the upstream slope consists of earth and is inclined at 1½H:1V. Brush is growing on the earthen portion of the upstream slope. A similar concrete training wall extends upstream 39 feet forming the east abutment along the east bank of the approach channel.

West of the spillway from the downstream edge of the crest of the embankment is a vertical, stone-masonry retaining wall. This wall extends from the gated spillway structure to a point near the west abutment. The wall is in poor condition - the mortar in the joints is deteriorated and a couple of blocks of rock are missing near the sinkhole on the crest which is described above. Brush is growing along the base of this wall. (See Appendix C - Figure 6.) Between the end of the wall and the west abutment is a motorcycle path, bare of vegetation, which leads up the slope and across the crest of the earth embankment to the small bridge which spans the approach channel approximately 200 feet upstream of the dam. (See Appendix C - Figure 7.)

A significant quantity of leakage is discharging from the contact between bedrock and the concrete foundation wall of an

abandoned building located on the west bank of the downstream channel at the toe of the dam. (See Appendix C - Figure 8.) On the basis of the visual inspection alone, it cannot be determined whether this leakage is taking place through the embankment and/or its foundation, whether it is associated with the gated spillway structure, or if the leakage is from pipes in the abandoned building. A drain pipe in the concrete foundation wall about 4 feet higher than the wall - bedrock contact where the leakage is taking place, was discharging water at the time of the inspection. The source of this water could not be determined on the basis of the visual inspection.

c. Appurtenant Structures. A concrete gated spillway structure is located between the earthen embankment and the east abutment of the dam. It has 5 bays, each 4.5 feet wide, which are separated by 18-inch concrete pier supports. (See Appendix C - Figure 4.) Rectangular, vertical lift, wooden gates, 6.4 feet high and 4.5 feet wide, are located in the four most western bays. The original top of the gates was about 1.3 feet higher than the present top of gates. The top two boards of the gates were cut with a saw and removed at an earlier date. Each gate is operated by a steel rack and pinion mechanism. Surface rust appears on the gate mechanisms which show no evidence of recent lubrication. Later it was found that 2 of the 4 gates are operable; the other 2 could be made so with minor repairs.

The fifth bay, which is located below the abandoned building, is completely blocked off with wooden boards. The concrete in this structure is in fair to poor condition. The concrete on the upstream face of the piers between the gate bays is eroded to a maximum depth of one inch, leaving the surface aggregate exposed. One concrete pier at the east side of the structure is very badly eroded at its base and reinforcing bars are exposed in the eroded area. The other two piers have minor erosion at the base. The steel gate slots are rusted, as is the steel service bridge over the spillway. Wooden planking on the service bridge is in poor condition and badly deteriorated. (See Appendix C - Figure 5.) The concrete of the spillway structure is rust-stained where steel members are embedded in it. Steel handrails located on both sides of the service bridge are rusted.

Beyond the flat-bottomed portion of the spillway is a downstream sloping spillway apron, inclined at 4H:1V, which discharges over a vertical concrete wall about 3.8 feet high. (See Appendix C - Figure 11.) The surface of the concrete apron is seriously eroded and coarse aggregate is exposed. Water is discharging into several holes along the joint between the flat-bottomed portion of the spillway and the sloping spillway apron. Where this water exits could not be determined, but it was noted that two 6-inch pipes, projecting through the vertical wall at the downstream end of the apron, were discharging water at the time of the inspection. The leakage at

the contact between bedrock and the concrete foundation wall on the west bank of the downstream channel (described above) is adjacent to and immediately downstream of the spillway structure.

d. Reservoir Area. The watershed above the reservoir is rolling and partially wooded. A number of houses are located on the shore of the reservoir. (See Appendix C - Figure 12.) No evidence of significant sedimentation in the reservoir was observed.

e. Downstream Channel. The downstream channel (Whitney Brook) is narrow with steep vertical stone masonry walls and a rock strewn channel bottom. On both banks of the channel, immediately downstream of the gated spillway structure, are located abandoned buildings. Approximately 75 feet downstream of the gated spillway structure, an enclosed wooden walkway which connects abandoned buildings on opposite banks of the channel crosses over Whitney Brook. (See Appendix C - Figures 13 & 14.) Four road bridges span the reach of the brook between Lake Anasagunticook Dam and the confluence of Whitney Brook with the Androscoggin River 2.1 miles downstream of the dam.

3.2 Evaluation

Based on the visual inspection, Lake Anasagunticook Dam is in poor condition.

A sinkhole in the crest of the embankment is evidence of past internal erosion of the embankment which, if allowed to continue, could result in breaching of the embankment.

The poor condition of the stone-masonry retaining wall at the downstream edge of the crest of the embankment, particularly the poor condition of the mortar and the missing blocks of rock could lead to failure of the wall. This could, in turn, be conducive to erosion and internal piping of the embankment.

A motorcycle path, bare of vegetation, on the crest and downstream slope of the dam near the west abutment, could lead to further erosion and possible breaching of the embankment, especially if it should be overtopped.

Brush is growing on the upstream slope and at the downstream toe of the embankment and, if not cleared, will grow into trees. If the trees blow over and pull out their roots, or if a tree dies and its roots rot, serious seepage and erosion problems may result.

Deterioration of the concrete gated spillway structure, particularly erosion of the bases of the concrete piers between the gate bays and holes along the joint between the flat-

bottomed part of the spillway and the sloping apron, is sufficiently serious that it could result in structural failure of the spillway.

Rusting of the steel gate slots and the absence of recent lubrication to rack and pinion lift mechanisms for the gates may make it difficult or impossible to raise the gates during floodflow or emergency conditions.

The poor condition of the planking on the service bridge makes it an operational hazard. Rusting of the steel members of the service bridge, if not stopped, can threaten the structural integrity of the bridge. Rusting of the hand rails, if allowed to continue, may make them an operational hazard.

Leakage, of undetermined origin, at the contact between bedrock and a concrete building-foundation wall on the left bank of the downstream channel at the toe of the dam, may be an indication of a developing problem.

Brush overhanging the upstream approach channel to the spillway could contribute to clogging of the spillway during floodflow conditions.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures were disclosed for Lake Anasagunticook Dam.

4.2 Maintenance of Dam

Brindis Leather Company is responsible for the maintenance of Lake Anasagunticook Dam.

4.3 Maintenance of Operating Facilities

No formal maintenance program was disclosed.

4.4 Description of Any Warning System in Effect

No written warning system was disclosed for Lake Anasagunticook Dam.

4.5 Evaluation

The present operational and maintenance procedures are not adequate to ensure that all problems encountered be remedied within a reasonable amount of time.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Lake Anasagunticook Dam is a low dam which impounds a reservoir of intermediate size. The dam consists of an earthen embankment and a concrete gated spillway structure controlled by 4 wooden gates. The length of the earth embankment is about 150 feet and the length of the gated spillway is approximately 25 feet. During floodflow conditions, a low-lying area located on the east bank of the approach channel, approximately 75 feet upstream of the gated spillway structure, will become an overflow area. The minimum elevation of this area is about 2.6 feet above spillway crest.

b. Design Data. No design data were disclosed.

c. Experience Data. According to Chester Dike, Town of Canton Selectman, overflow of the earthen embankment occurred in 1936 and resulted in little damage. No detailed information on the amount of flow or depth of flooding resulting from this overtopping was disclosed.

d. Visual Observations. At the time of inspection, it could not be determined from visual evidence whether damage to the portions of the dam embankment and the concrete gated spillway structure (See Section 3.1) was the result of excessive discharges.

e. Test Flood Analysis. Lake Anasagunticook dam is classified as being intermediate in size, having a hydraulic height of 20 feet and a maximum storage capacity of 5,800 acre-feet. Using the Recommended Guidelines for Safety Inspection of Dam, the test flood may range from ½ Probable Maximum Flood (PMF) to the Probable Maximum Flood. A test flood equal to ½ PMF was selected because the dam's size is in the lower range of the intermediate size classification. The watershed above the dam, determined to have an average slope of 164.4 feet per mile and to possess significant amounts of storage, was classified as rolling. From the PMF Peak Flow Rates graph, the peak inflow discharge for a rolling watershed having a drainage area of 14.95 square miles is 22,875 cubic feet per second (CFS) (1,530 csm). Therefore, the test flood inflow was determined to be 11,438 cfs. Using the procedure outlined in Estimating Effect of Surcharge Storage on Maximum Probable Discharges issued by the Corps, to determine the modifying effect of surcharge storage on the test flood inflow discharge, the test flood outflow was calculated to be 9,900 cfs (662 csm). Analysis

of the elevation versus discharge curve indicates that a discharge of this magnitude (9,900 cfs) would result in an elevation of 408.0' MSL, assuming all gates closed, and would result in the overtopping of the dam by 3.8 feet. The maximum spillway capacity at top of dam is 180 cfs (assuming gates closed), which is 1.8 percent of the test flood discharge.

f. Dam Failure Analysis. The impact of failure of the dam with the reservoir at top of dam was assessed assuming a major breach could occur at two different portions of the dam; the concrete gated spillway structure and the earthen embankment. Both breach analyses were performed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis of a breach of the earth embankment produced the most severe downstream hazard and, therefore, was used to determine the hazard classification of the dam.

The analysis of the breach of the earthen embankment covered a reach extending from the downstream face of the embankment to a point on Whitney Brook just downstream of a town road bridge crossing approximately 1,200 feet downstream of the dam. Flow resulting from a breach of the earth embankment could be expected to be carried along State Route 140 for a length of about 400 feet before joining Whitney Brook at a point just downstream of the State Route 140 bridge crossing over the brook. A breach of the earth embankment at top of dam would result in a stage depth of 3.1 feet (no flow is the antecedent condition), at a point approximately 200 feet downstream of the embankment. This stage depth could result in the loss of a few lives and probably result in appreciable property damage to residential and commercial structures located along State Route 140. The dam was therefore classified Significant Hazard.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. A sinkhole in the crest of the embankment is evidence of past internal erosion of the embankment, which, if allowed to continue, could result in breaching of the embankment. The poor condition of the stone-masonry retaining wall at the downstream edge of the crest of the earth embankment, particularly the poor condition of the mortar and the missing blocks of rock could lead to failure of the wall and is conducive to erosion and internal piping of the embankment. A motorcycle path, bare of vegetation, on the crest and downstream slope of the dam near the west abutment could lead to further erosion and breaching of the embankment, especially if it should be overtopped.

Brush is growing on the upstream slope and at the downstream toe of the embankment and, if not cleared, will grow into trees. If the trees blow over and pull out their roots, or if a tree dies and its roots rot, serious seepage and erosion problems may result. Deterioration of the concrete gated spillway structure, particularly erosion of the bases of the concrete piers between the gate bays and holes along the joint between the flat-bottomed part of the spillway and the sloping apron, is sufficiently serious that it could result in structural failure of the spillway. Two of the four gates are not operable.

Leakage, of undetermined origin, at the contact between bedrock and a concrete building-foundation wall on the west bank of the downstream channel at the toe of the dam, may be an indication of a developing problem.

b. Design and Construction Data. No design and construction data are available.

c. Operating Records. No operating records were disclosed.

d. Post-Construction Changes. See Section 1.2 h.

e. Seismic Stability. This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Lake Anasaguntlcook Dam is in poor condition. The major concerns with respect to the integrity of the dam, if left uncorrected, are:

(1) Sinkhole in the crest of the earthen embankment.

(2) Deteriorated condition of the stone-masonry retaining wall at the western downstream side of the earthen embankment.

(3) Trespassing (motorcycle path) on the crest and downstream slope of the dam near the west abutment.

(4) Deterioration of the concrete in the gated spillway structure, especially erosion at the base of the piers between the gate bays and holes at the joint between the flat-bottomed portion of the spillway and the sloping apron on the downstream side of the spillway.

(5) Rusting of the steel gate slots.

(6) Rusting of the steel members and deterioration of the wooden planking of the service bridge.

(7) Leakage, of undetermined origin, at the contact between bedrock and a concrete building-foundation wall on the west bank of the downstream channel.

(8) Inoperability of 2 of the 4 gates.

(9) Brush growing on the upstream slope and at the downstream toe of the embankment.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I report.

d. Need for Additional Information. Additional information is not required for the purposes of this Phase I inspection.

7.2 Recommendations

The owner should engage a Registered Professional Engineer to:

(1) Investigate the sinkhole in the crest of the dam and design appropriate remedial measures.

(2) Design repairs for the stone-masonry retaining wall on the western downstream side of the dam.

(3) Design repairs for the deteriorated concrete gated spillway structure.

(4) Investigate the leakage at the contact between bedrock and the concrete building-foundation wall on the west bank of the downstream channel and design remedial measures, if needed.

(5) Conduct detailed hydrologic and hydraulic evaluation to determine need and method of attaining increased discharge capacity.

The owner should carry out the recommendations made by the engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Control trespassing on the dam near the west abutment and re-establish grassy vegetation on the existing motorcycle path.

(2) Clear brush from the upstream slope of the embankment, on the upstream approach channel, and from the area near the downstream toe.

(3) Repair the rusted gate slots.

(4) Ensure the operability of all four gates.

(5) Maintain the steel members of the service bridge free of rust and replace the deteriorated planking on the service bridge.

(6) Visually inspect the dam and appurtenant structures once a month.

(7) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once every year.

(8) Establish a surveillance program for use during and immediately after heavy rainfall and also a downstream warning program to follow in case of emergency conditions. Establish also an operation plan for opening all gates during heavy rainfall.

7.4 Alternatives.

None recommended.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Lake Anasagunticook Dam, ME DATE Sept. 18, 1979

TIME P.M.

WEATHER Clear, warm

W.S. ELEV. U.S. 400.7 DN.S. 387

PARTY:

1. Warren Guinan (ANCo)
2. Stephen Gilman (ANCo)
3. Ron Hirschfeld (GEI)
4. John Regan (ANCo)
5. Terry Sapp (ANCo)
6. Leslie Williams (ANCo)
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	W. Guinan/J. Regan	
2.	Structural Stability	S. Gilman	
3.	Soils & Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Anasaguntticook Dam, ME DATE Sept. 18, 1979

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	404.2' MSL
Current Pool Elevation	400.7' MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	Not paved
Movement or Settlement of Crest	Sinkhole in crest near spillway
Lateral Movement	None observed
Vertical Alignment	Good, except for sinkhole noted above
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Motorcycle trail on crest and downstream slope near left abutment
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	Vertical stone masonry wall at downstream side of embankment has several rock blocks missing
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Grass on crest, brush on upstream slope and next to toe of downstream of masonry wall

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Anasaguntiocook DATE Sept. 18, 1979

PROJECT FEATURE Intake Channel and Intake Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Brush growing on slopes
Bottom Conditions	Soil and boulder covered
Rock Slides or Falls	None
Log Boom	None
Debris	Some sticks and minor debris found in approach to gates
Condition of Concrete Lining	Good
Drains or Weep Holes	None observed
b. Intake Structure	
Condition of Concrete	Upstream face of concrete piers eroded to maximum depth of 1", exposing aggregate
Gates and Slots	Steel gate slots are rusted

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Anasaguntticook DATE Sept. 18, 1979

PROJECT FEATURE Outlet Works - Control Tower NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Not applicable
Condition of Joints	Not applicable
Spalling	Not applicable
Visible Reinforcing	Not applicable
Rusting or Staining of Concrete	Not applicable
Any Seepage or Efflorescence	Not applicable
Joint Alignment	Not applicable
Unusual Seepage or Leaks in Gate Chamber	Not applicable
Cracks	Not applicable
Rusting or Corrosion of Steel	Not applicable
b. Mechanical and Electrical	
Air Vents	Not applicable
Float Wells	Not applicable
Crane Hoist	Not applicable
Elevator	Not applicable
Hydraulic System	Not applicable
Service Gates	Four 4.5'W x 6.4'H wood gates in fair condition. Surface rust observed on rack and pinion lift mechanism. (Fair condition) and no visible evidence of recent lubrication.
Emergency Gates	
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System	None

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Anasaguntiocook Dam, ME DATE Sept. 18, 1979

PROJECT FEATURE Spillway Weir, Approach and Discharge Channels NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Gated Spillway (for gate information see page A-4)
a. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Brush on both banks of approach channel
Floor of Approach Channel	Soil and boulder covered bottom
b. Weir and Training Walls	
General Condition of Concrete	Fair
Rust or Staining	None visible
Spalling	None visible
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	None observed
Drain Holes	None observed
c. Discharge Channel	Concrete spillway apron
General Condition	Fair to poor (See notes below)
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees overhang discharge channel approximately 100 feet downstream of spillway apron
Floor of Channel	Surface of concrete apron is cracked exposing aggregate
Other Obstructions	An enclosed walkway across channel between abandoned buildings on either side of channel

NOTES: 1. Water flowing into several holes at upstream edge of spillway apron at joint with gate structure.
2. Water discharging from two 6-inch pipes at vertical concrete wall at downstream end of spillway.

PERIODIC INSPECTION CHECKLIST

PROJECT Lake Anasagunticook Dam, ME DATE Sept. 18, 1979

PROJECT FEATURE Service Bridge NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	
Bearings	Not applicable
Anchor Bolts	Not applicable
Bridge Seat	Not applicable
Longitudinal Members	Steel with some surface rust
Underside of Deck	Not visible
Secondary Bracing	None
Deck	Wooden planking in poor condition and badly deteriorated
Drainage System	Not applicable
Railings	Steel with some surface rust
Expansion Joints	Not applicable
Paint	Fair condition, some rust evident
b. Abutment & Piers	
General Condition of Concrete	Fair to poor. Eroded at base of one pier exposing reinforcing bars
Alignment of Abutment	Bood
Approach to Bridge	Good
Condition of Seat & Backwall	Not applicable

PROJECT Lake Anasagunticook Dam, ME

DATE Sept. 18, 1979

PROJECT FEATURE Reservoir

NAME J. Regan

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	None observed
Changes in Watershed Runoff Potential	None significant
Upstream Hazards	None
Downstream Hazards	Residential and commercial structures downstream of earthen embankment
Alert Facilities	None posted
Hydrometeorological Gages	None observed
Operational & Maintenance Regulations	None posted

APPENDIX B

ENGINEERING DATA

APPLICATION FOR DAM REGISTRATION

Dam Registration Number 0116
Date Received JUL 28 1976
Fee Enclosed $10.00
Quad Sheet Name Canton
Quad Sheet Number M-4-NE

Location:

County: OXFORD
Municipality: CANTON
Name of Dam: (NONE)
Name of Impoundment: ANASAGUNTICOOK LAKE — DO NOT KNOW SIZE + IF IT IS REGARDED AS A GREAT POND — DO NOT HAVE ANY MAPS — WE ARE CLOSING OUR OPERATION AS OF 9-1-76.

Ownership:

Name of Owner: BRINDIS LEATHER CO
Name of Agent: (if different from Owner)
Address of Owner: CANTON MAINE (Brindis Tanning Co., 57 Washington St. Haverhill, Mass. 01830)
Address:
Telephone Number: 597-3241
Telephone Number:

Description of Dam

Type: GATE TYPE
Construction Material: CONCRETE (Concrete, wood, earth)
Year Originally built: DO NOT KNOW
Year last major repair: 2-3 YEARS AGO
Height: DO NOT KNOW
Width: DO NOT KNOW
Spillway type: YES
Spillway Width: DO NOT KNOW
Impounding Capacity: DO NOT KNOW (Acre-feet)
Drawdown available: DO NOT KNOW (feet)
Fish Passage available?: DO NOT KNOW
Installed Electrical Generating Cap: ?
Purposes for which stored water is used: CONTROL FLOW OF STREAM + AT ONE TIME GENERATED POWER
Most recent inspection by Qualified Engineer (Date): NONE
Name and Address of Engineer:
Other Permits applicable:

Maine Department of Agriculture

Joseph N. Williams, Commissioner

REPLY TO:
MAINE SOIL and WATER
CONSERVATION COMMISSION
[illegible] Executive Director
[illegible] Augusta, Maine 04333
[illegible]

November 13, 1978

Board of Selectmen
Canton
Maine 04221

Gentlemen:

Enclosed you will find a letter from George J. Brindis, owner of the dam on Anasagunticook Lake.

After the Finding of Fact and Order was prepared for Anasagunticook Lake, I wrote a letter to Mr. Brindis suggesting that the operation of the dam be turned over to you gentlemen. The Commission felt that this might be helpful to you in preparing for the flood problem you have with the Androscoggin River each spring. Upon receiving a letter from Mr. Brindis, I called him and assured him that this was just a suggestion by the Commission and that his terms as stated in the enclosed letter were certainly very acceptable to us.

If you have any questions or if I can be of further assistance to you, please do not hesitate to contact me.

Sincerely,

Frank W. Ricker
Executive Director
Maine Soil & Water
Conservation Commission

FWR:sc

Enclosure

TELEPHONE AREA CODE 617 376-8687

BRINDIS LEATHER CO., Inc.

TANNERS

ROLLED AND NOVELTY SHEEPSKINS
P.O. Box 1446
57-65 WASHINGTON STREET
HAVERHILL, MASSACHUSETTS

September 28, 1978

Maine Soil & Water Conservation & Commission
Frank W. Ricker, Executive Director
State Office Building
Augusta, Maine 04333

Dear Mr. Ricker:

In reference to your letter of September 21, we are in agreement that the Selectmen of Canton should regulate the dam on our property while our building is not occupied and we do herewith grant our permission. We do make one reservation, however, which we think should be allowed. That is if we should reoccupy the building or should sell the property, the new owner should have the perogative of the operation of the dam within the limits as set up in the findings of fact dated 13 September 1978.

Very truly yours,

BRINDIS LEATHER CO., INC.

George J. Brindis

GJB/mm

ESTABLISHMENT OF WATER LEVEL)
FOR ANASAGUNTICOOK LAKE) FINDING OF FACT AND ORDER
CANTON-HARTFORD, MAINE)

On July 13, 1978, the Soil and Water Conservation Commission in answer to a petition signed by 10% of the littoral proprietors of Anasagunticook Lake in Canton-Hartford, Maine, held a hearing in Canton, Maine, to establish a normal water level for Anasagunticook Lake.

FINDINGS OF FACT

After reviewing the testimony submitted at the July 13, 1978, hearing, the Commission finds the following facts:

1. The dam owner makes no beneficial use of the dam.

2. The Department of Inland Fisheries and Wildlife are managing the lake for Brown Trout and Smallmouth Bass. Smallmouth Bass require stable water levels from May through June 20th. The water levels should also remain stable for Brown Trout from mid September through October.

3. The maximum traditional level is 5" below the topmost board in the gates.

4. At the time of the hearing, the level was 23" below the topmost board in the gates.

5. Canton has experienced serious spring flooding from the Androscoggin River. It would be most advantageous to the Town of Canton if they had some reservoir capacity in the lake during this period so that the runoff into the river from Anasagunticook could be controlled.

THEREFORE, the Commission finds on the basis of the evidence submitted at a public hearing with respect to which all parties in interest were given ample notice, that there is sufficient justification for the establishment by the Commission, pursuant to the provisions of 12 M.R.S.A. 304(4), of normal water levels at Anasagunticook Lake located in the Towns of Canton and Hartford, County of Oxford, and State of Maine, and hereby ORDERS:

1. The owner will maintain a water level at Anasagunticook Lake from on or about June 1 through October not to exceed a maximum level of 5" below the topmost board in the gates. Once that level is reached, the owner should not manipulate the dam except to assure that the level does not exceed the maximum level. Throughout the summer months, the only lowering of water below 5" below the topmost boards of the gates should be due to natural causes.

2. During the period from November 1 to April 15, the dam owner will drawdown the lake to a necessary level to provide some reservoir capacity to assist the Town of Canton in flood control during spring run-off.

3. After April 15, the owner will regulate the flow out of Anasagunticook Lake to bring the water to the maximum level set by the Commission on or about June 1.

4. In September of 1979, the Executive Director will make himself available to attend a meeting called by interested parties and the dam owner to discuss the past summer season at Anasaguntic ook. At this meeting, the parties will attempt to resolve any problems resultant from the Commission's Order. If deemed necessary, possible amendment to the Commission Order will be discussed.

DONE AND DATED AT AUGUSTA, MAINE, THIS 13th DAY OF SEPTEMBER, 1978.

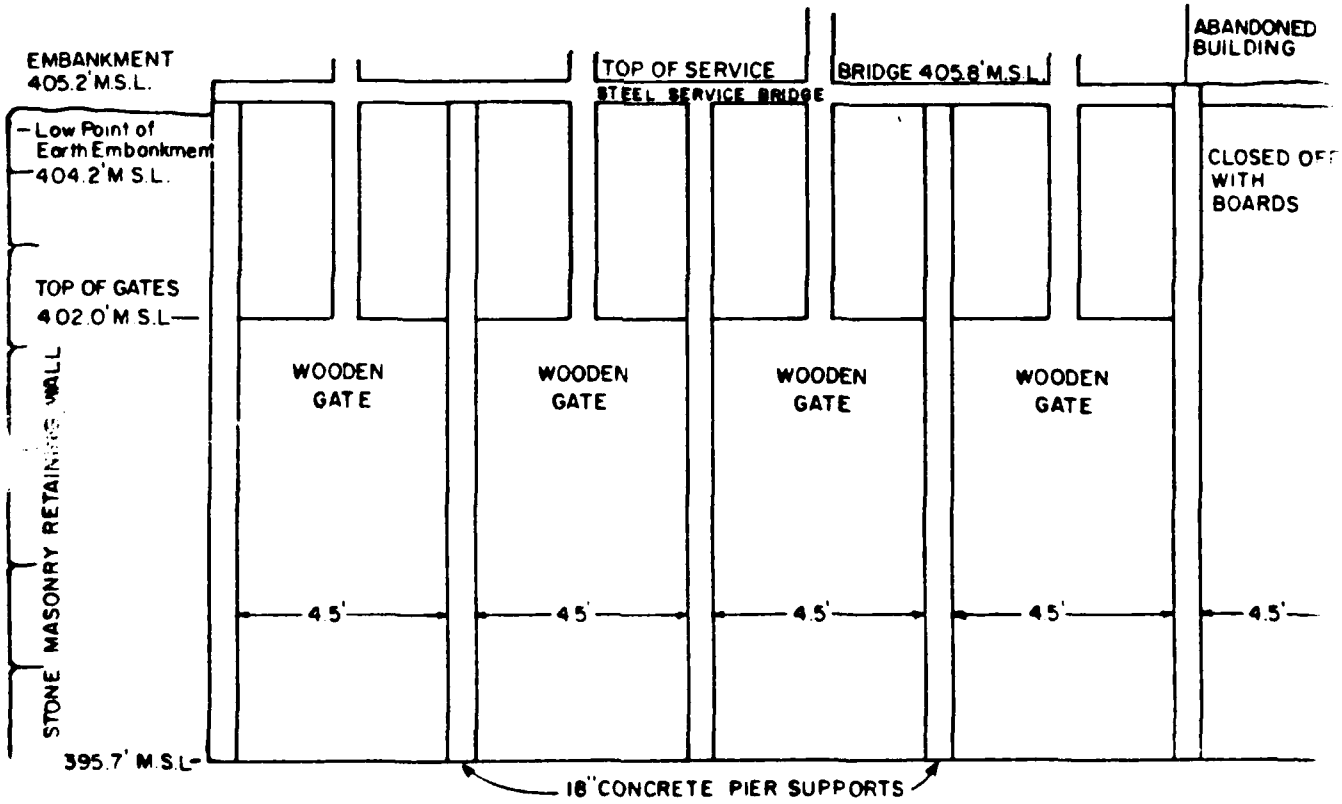
SOIL AND WATER CONSERVATION COMMISSION

BY _____
John Fogler, Chairman

12 M.R.S.A., Chapter 6, Subsection 307. Appeal

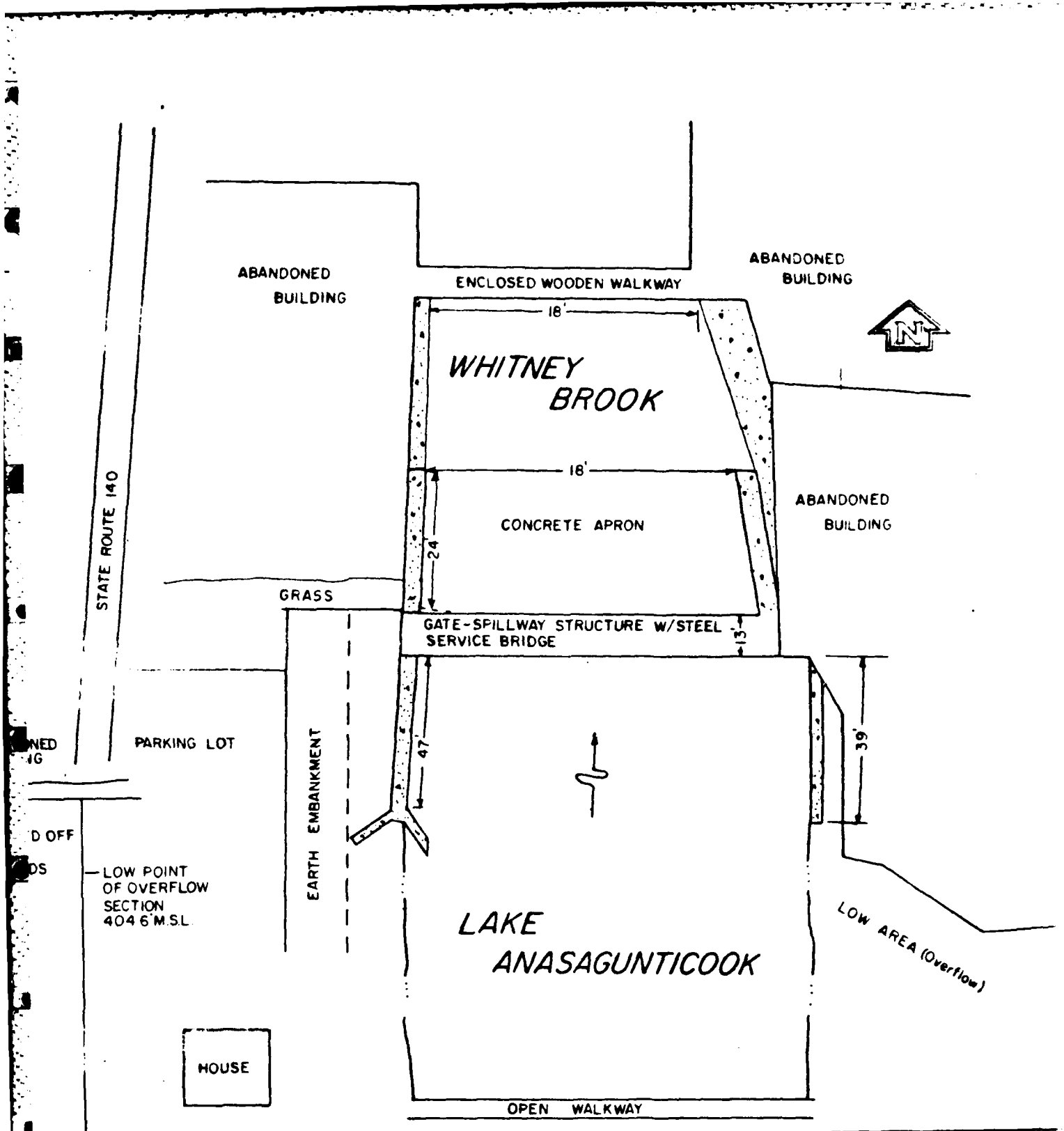
Any person aggrieved by an order of the Commission may appeal to the Superior Court pursuant to Title 5, Chapter 375, Subchapter VII, within 30 days of notice thereof.

This Finding of Fact and Order will be recorded in the Oxford County Registry of Deeds by the Commission.



ELEVATION

NO



PLAN

NOTE: ALL ELEVATIONS ARE BASED ON ASSUMED NORMAL POOL ELEVATION OF 402' M.S.L. DATUM (N.G.V.D.)

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE ANASAGUNTICOOK DAM

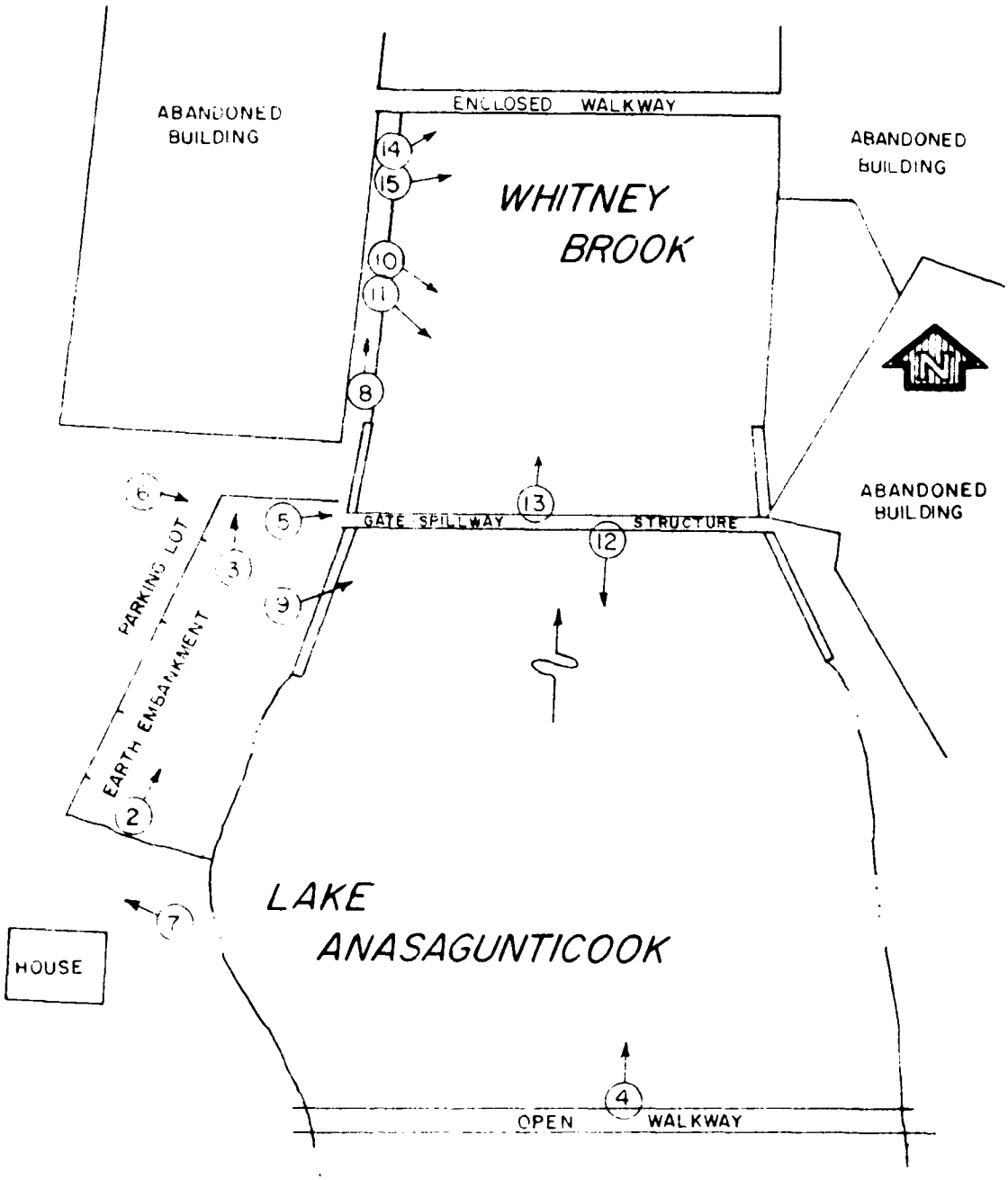
WHITNEY BROOK — MAINE

SCALE NOT TO SCALE

DATE NOVEMBER 1979

APPENDIX C

PHOTOGRAPHS



[illegible] NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

WHITNEY BROOK — MAINE

			SCALE: NOT TO SCALE
			DATE: NOVEMBER 1978

September 18, 1979

Figure 2 - Looking north across crest of earth embankment. Note growth of brush on embankment sides.

September 18, 1979

Figure 3 - Looking at sinkhole in earth embankment.

September 18, 1979

Figure 6 - Looking at stone masonry retaining wall of the earth embankment. Note missing blocks.

September 18, 1979

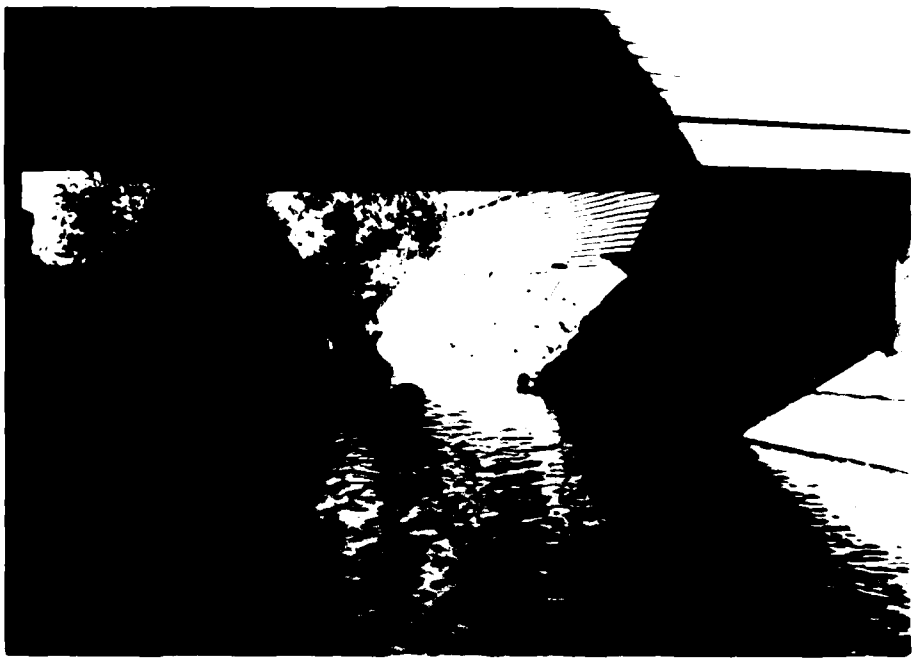
Figure 7 - Looking at evidence of trespassing on west abutment (motorcycle path).

September 18, 1979

Figure 10 - Looking at erosion at base of eastern most pier support of gated spillway structure.

September 18, 1979

Figure 11 - Looking at concrete spillway apron from west bank of downstream channel.

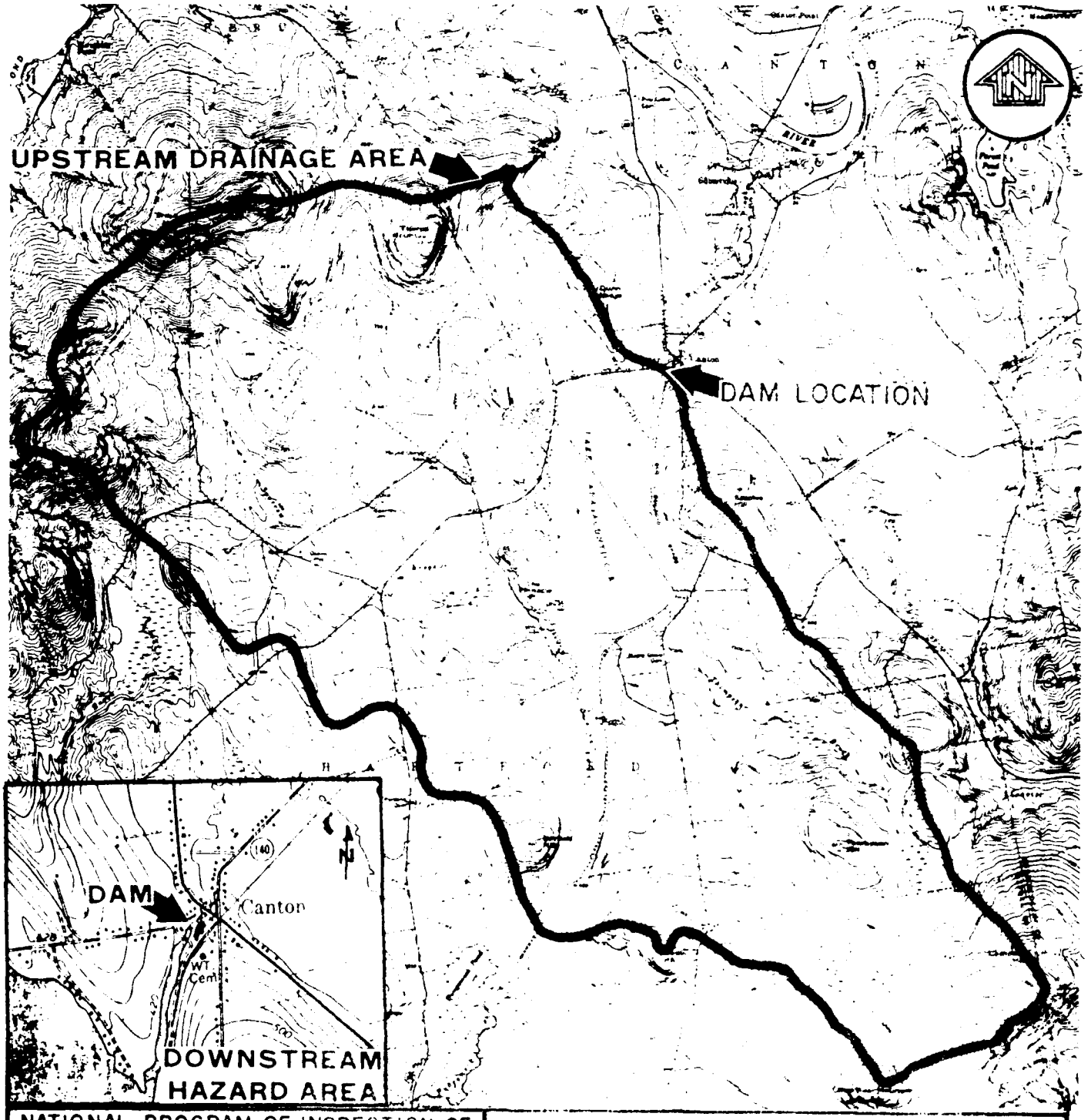


September 18, 1979
Figure 14 - Looking at downstream channel from west bank of spillway apron.

September 18, 1979
Figure 15 - Looking at deteriorated condition of the concrete at the east wall of the downstream channel.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LAKE ANASAGUNTICOOK DAM
CANTON, MAINE

REGIONAL VICINITY MAP

NOVEMBER 1979

DEPARTMENT OF THE [illegible]
NEW ENGLAND DIVISION, CORPS OF [illegible]
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC [illegible]

MAP BASED ON USGS 7½ MINUTE QUADRANGLE [illegible] AND CANTON,

SQUARES 1/4 IN SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

BREACH ANALYSIS

A breach may occur at two different sections of the dam. The usual breach analyses [illegible] breach occurs @ the spillway, [illegible] Lake Amoskeag dam breach is [illegible] likely to occur @ the earth embankment [illegible] end of the dam. Therefore the breach analysis was done @ two sections

1) Breach @ spillway section
2) Breach @ earth embankment.

The breach analysis that produces the most severe downstream hazards will be used to determine the dam's hazard classification.

Breach Analysis - Earth Embankment

Assumptions: 1) elevation of pool @ time of breach is equal to 404.2 (low point of earth embankment)

2) Breach width is equal to 0.4 length of earth embankment.

Length of embankment = 150'

$\therefore$ $0.4L = 60' = W_b$ (breach width)

$$Q_{p_1} = 8/27\, W_b \sqrt{g}\, Y_o^{3/2}$$ (From COE "Rule of Thumb" Guidance Estimating Downstream Dam Failure Hydrographs)

where Y_o = height from top of embankment-ground elevation of parking lot (this height varies, therefore assumed 8' as representative of breach section)

W_b = breach width

g = acceleration due to gravity

Q_{p_1} = peak failure outflow

$$Q_{p_1} = 8/27\, W_b \sqrt{g}\, Y_o^{3/2}$$

$= 2285\ cfs$

Downstream Hazard - Earth Embankment

1) The peak failure outflow (Q_{p_1}) would result in stage increase of 7.1 feet above the antecedent stage of 0 feet (no outlet to earth embankment) - @ x-section 200' d/s of earth embankment

SQUARES 1/4 IN. SCALE

BREACH ANALYSIS - Earth Embankment

CONCLUSIONS:

The expected stage depth of 3.1 Feet (antecedent condition is no Flow) may result in appreciable property damage to residential and commercial structures located along Route 140 with possible loss of a few lives expected (a potential for greater loss of life exists if the parking lot d/s of the embankment is occupied. ∴ SIGNIFICANT HAZARD

Anderson-Nichols & Company, Inc.

Subject _____

Sheet No. 4 of 19

Date _____

Computed _____

Checked _____

JOB NO. Lake [illegible]

SQUARES 1/4 IN. SCALE

Rating Curve Data for Typical section @ 200' downstream of earth embankment

Data generated from computer program of Manning's Equation on [illegible] HEC 2001 Series

Depth	Flow	[illegible]	[illegible]	[illegible]
0	[illegible]	0	0	0
0.5	390.5	20	49	77
1.0	391.0	47	59	294
1.5	391.5	77	61	630
2.0	392.0	107	62	1077
2.5	392.5	137	63	1606
3.0	393.0	167	64	2209
3.5	393.5	197	65	2876
4.0	394.0	227	66	3603
4.5	394.5	257	67	4383
5.0	395.0	287	68	5214
5.5	395.5	317	69	6091
6.0	396.0	341	70	7010
6.5	[illegible]	377	71	7970
7.0	[illegible]	407	72	8967
7.5	[illegible]	437	73	9994
8.0	[illegible]	467	74	11065
8.5	[illegible]	497	75	12161
9.0	[illegible]	527	76	13287

Manning's Eq.: $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

A = x-sectional [illegible]

n = roughness [illegible]

R = hyd[illegible]

S = slope

SMR
10-3-[illegible]

Anderson-Nichols & Company, Inc.

Subject _____

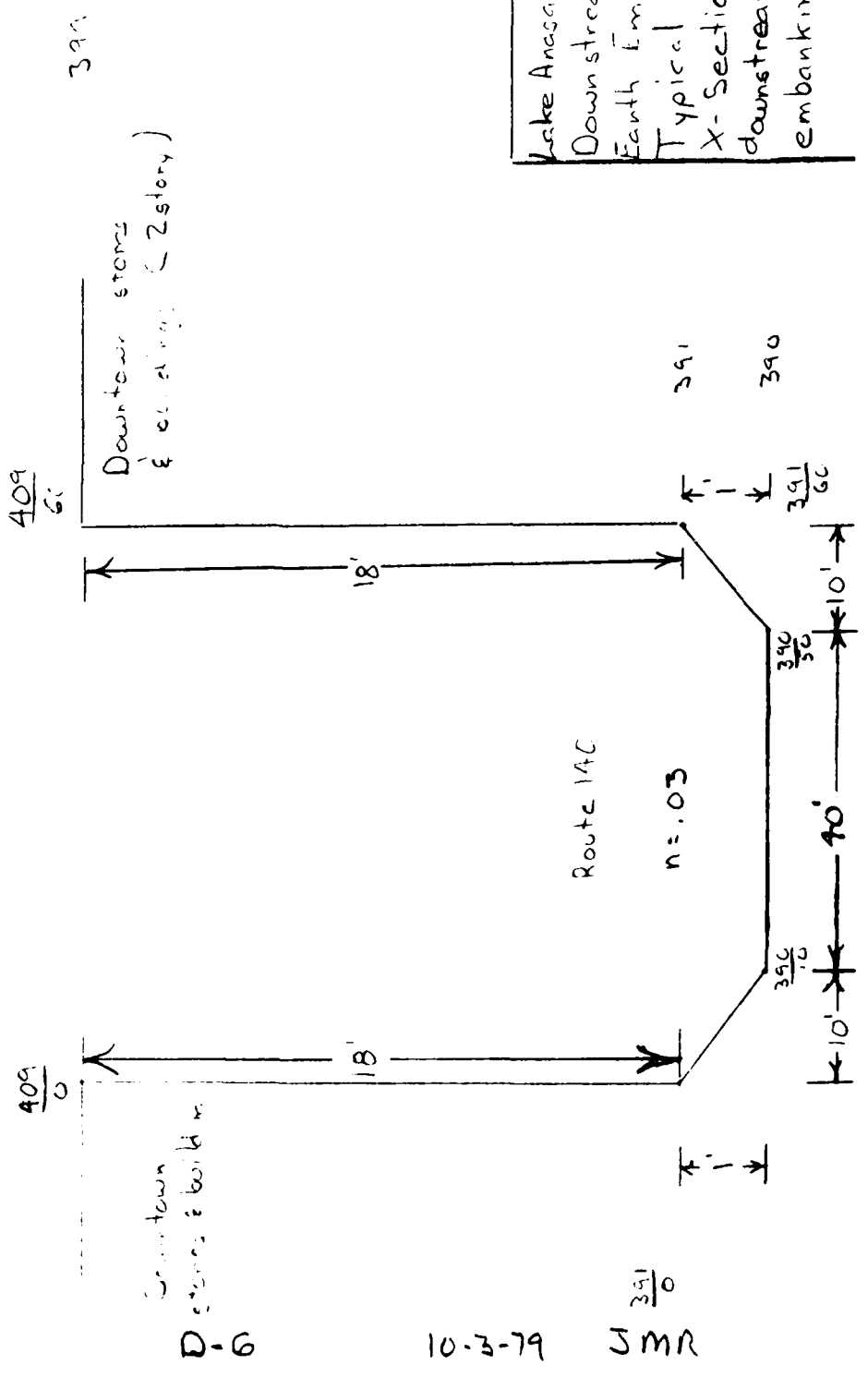
Sheet No. 5 of 19
Date 10-5-79
Computed JMR
Checked _____

JOB NO. Lake Anasaguntticook 3273-17

SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
1/4 IN. SCALE

Lake Anasaguntticook – Downstream Hazard – Earth Embankment – Typical Channel X-Section. 200' downstream of earth embankment

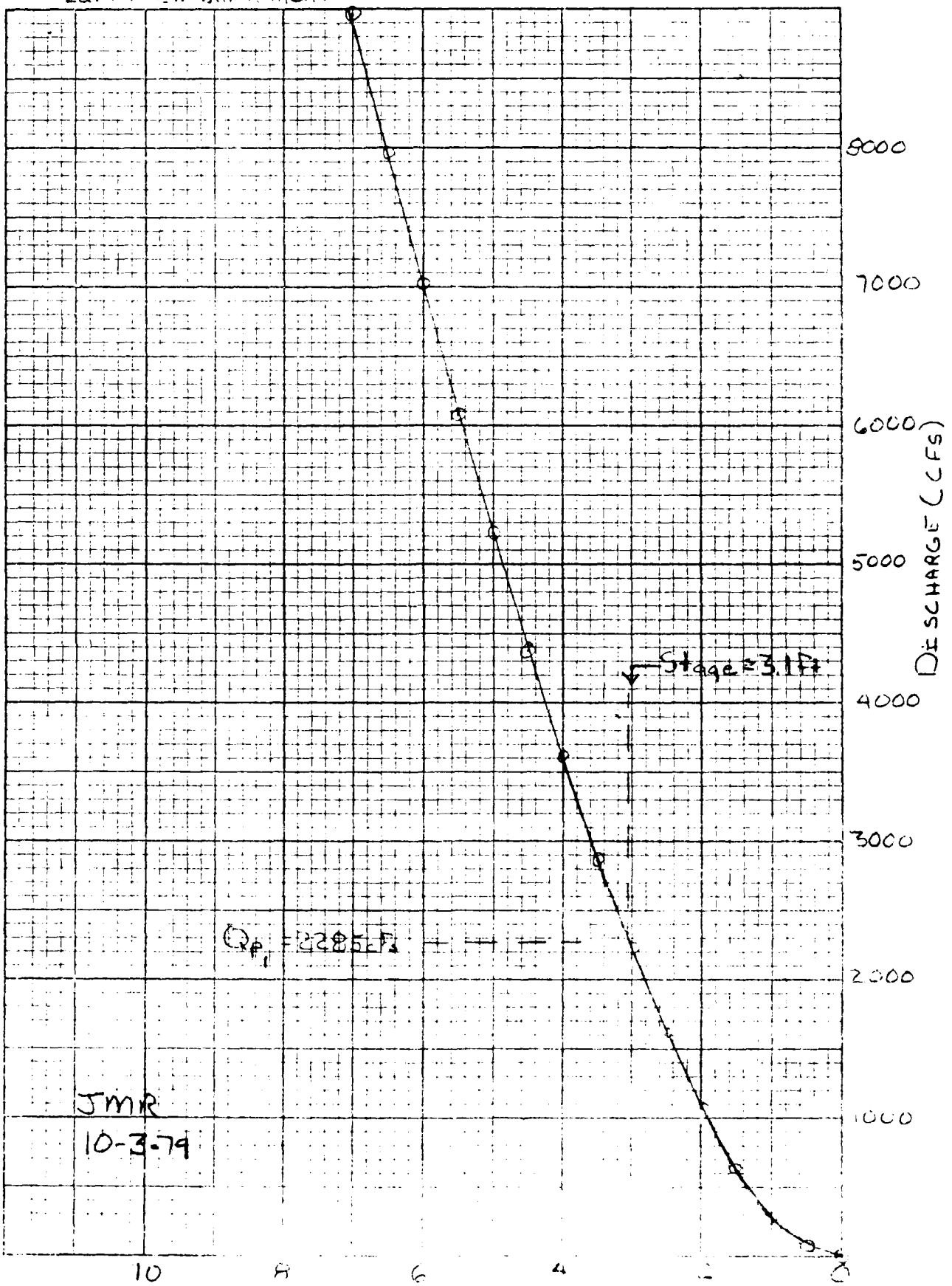
NOTE: In the event of a breach in the earth embankment of the dam resulting in a flow down Route 140 through town and flow to the ocean, flood waters would overtop Route 140 crossing.



D-6 10-3-79 JMR

Lake Ancsagorticook -

Downstream Hazard Rating Curve - 200' d/s of Earth Embankment



JMR
10-3-79

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Breach Analysis - Concrete Spillway

Assumptions:

1) Breach occurs @ elevation = 404.2 (low point of dam structure)

2) Whole spillway section will breach, ∴ $W_b = 28.5'$

3) Y_o = elev. of pool at time of breach - gate Invert

$Y_o = 404.2 - 395.6 = 8.6$

$Q_{p_1} = 8/27\ W_b \sqrt{g}\ Y_o^{3/2}$ (From COE "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs)

W_b = breach width = 28.5'
g = acceleration due to gravity = 32.2 ft/sec²
Y_o = breach height = 8.6

$Q_{p_1} = 8/27\ (28.5)\ \sqrt{32.2}\ (8.6)^{3/2}$

$Q_{p_1} = 1210$ cfs peak failure outflow

Total Breach Q = peak failure outflow (Q_{p_1})

$Q_{p_1} = 1210$ cfs

$Q_T = 1210 = 1210$ cfs

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Breach Analysis - Concrete Spillway (cont.)

Conclusions

1) Assuming no reach storage between Footbridge 200' d/s of dam and the dam, the total breach Q (1210 cfs) could result in a stage height of 4.5' which is a 3.4' stage increase above the antecedent (Q = 145 cfs) stage of 1.1'. The sill elevation of the buildings in the vicinity of the foot bridge are above the stage which could occur as a result of the breach. The concrete low section

2) Assuming no reach storage, the total breach discharge (Q = 1210 cfs) @ Route 108 crossing over Whitney Brook (approx 200' d/s of the dam) would result in stage of 5.1' which is a 3.7' stage increase above the antecedent stage (Q = 145 cfs) of 1.4'. The total breach discharge would be contained within the channel banks.

3) Assuming no reach storage, the total breach discharge (Q = 1210 cfs) @ Route 140 crossing over Whitney Brook could result in a stage of 5.1' which is a 3.9' stage increase above the antecedent discharge (Q = 145 cfs) of 1.2'. The total discharge would be contained within the channel banks.

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Conclusions: (cont.)

4) Assuming no reach storage, the total breach discharge (Q_T = 1210 cfs) @ a cross-section located 700' d/s of Route 140 could result in a stage of 6.0' which is an increase in stage of 4.3' feet above the antecedent discharge stage of 1.7'. The total breach discharge would be confined to the channel.

Anderson-Nichols & Company, Inc. Subject

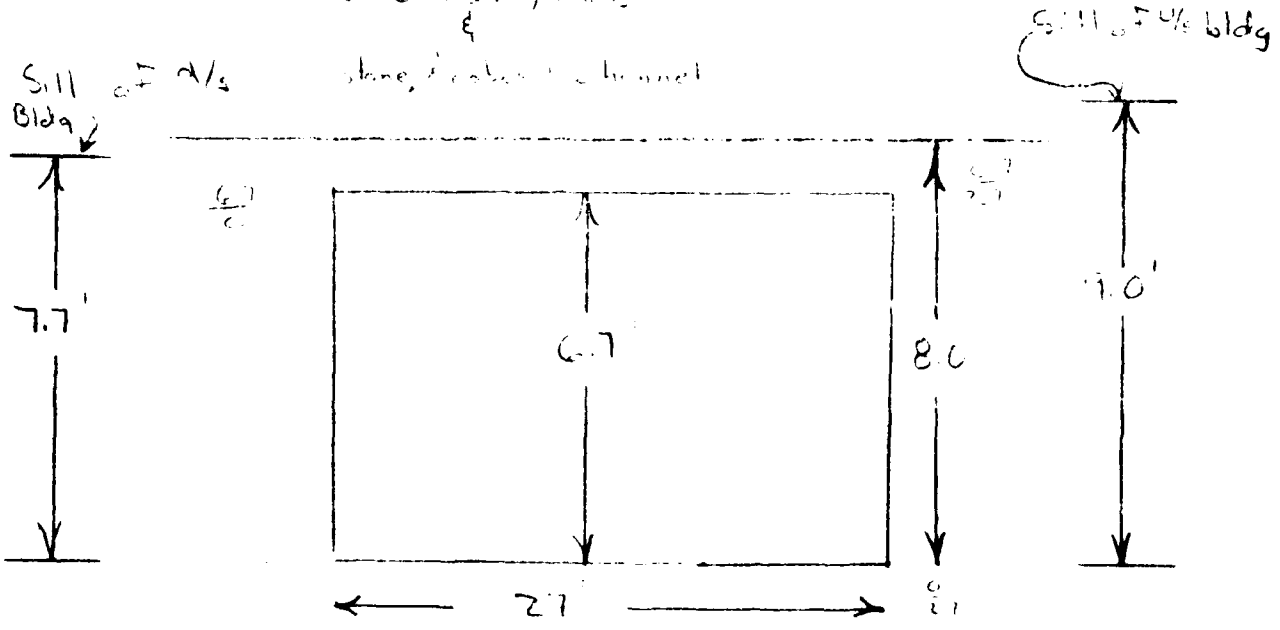
Sheet No. 10 of 19
Date
Computed
Checked

JOB NO. 3273-17 Lake Area

Downstream Hazard ... Concrete Spillway Breach

Footbridge 200' d/s of dam

deck width = 5'



n = 0.03

s = 0.00

Depth	Elev	Area		Q
0.0		0	0	0
0.4		12.1	27.9	34
0.8		22.9	29.7	67
1.2		33.7	29.5	102
1.6		44.5	30.3	134
2.0		55.3	31.1	172
2.4		66.1	31.9	211
2.8		76.9	32.7	251
3.2		87.7	33.5	294
3.6		98.5	34.3	338
4.0		109.3	35.1	384
4.4		120.1	35.9	432

Anderson-Nichols & Company, Inc. Subject _____

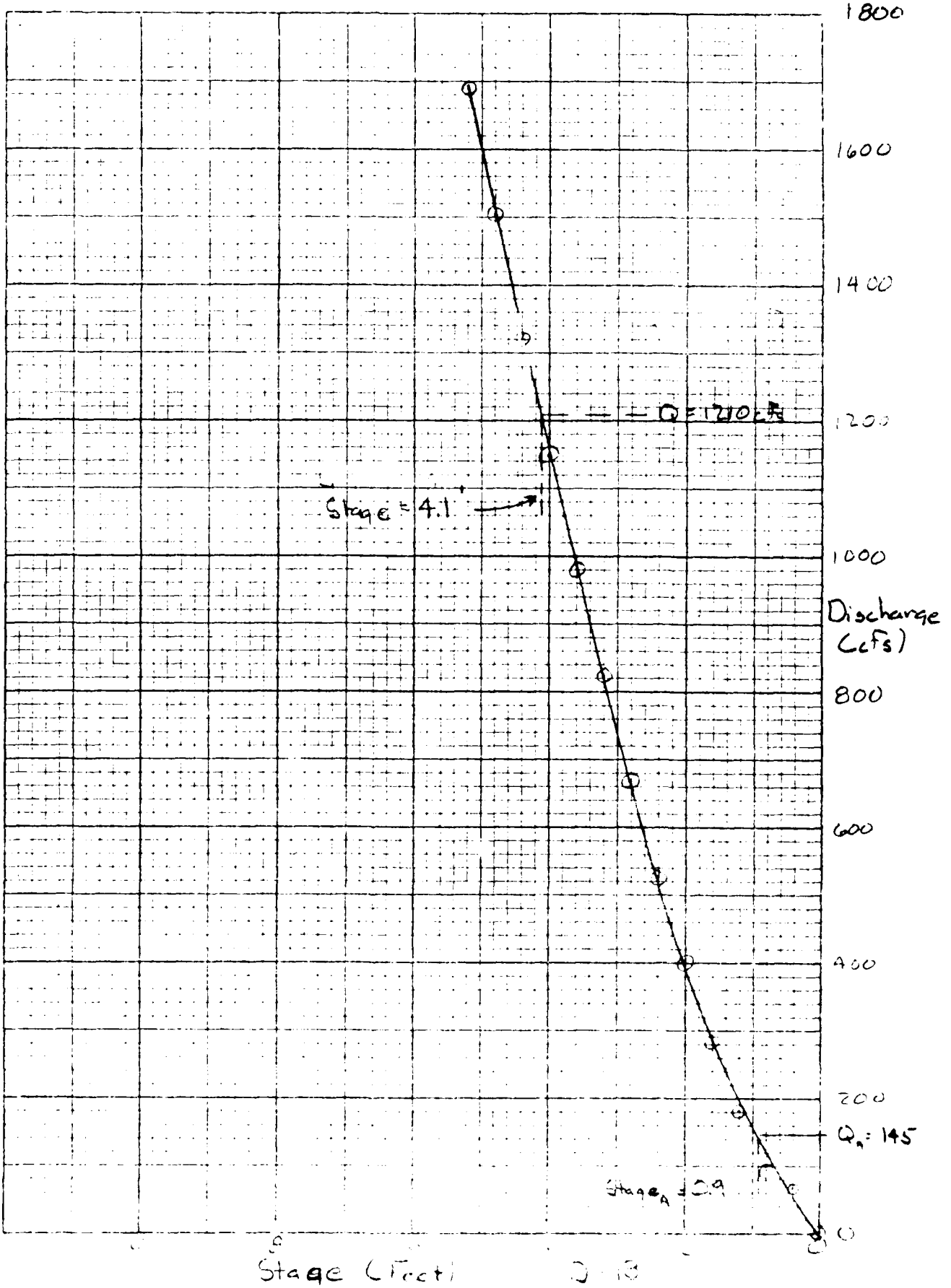
Sheet No. 11 of 19
Date 10-9-79
Computed JMR
Checked _____

JOB NO. Lake Anasaguntacook 3273
Footbridge 200' d/s of dam (cont.)

SQUARES 1/4 IN. SCALE

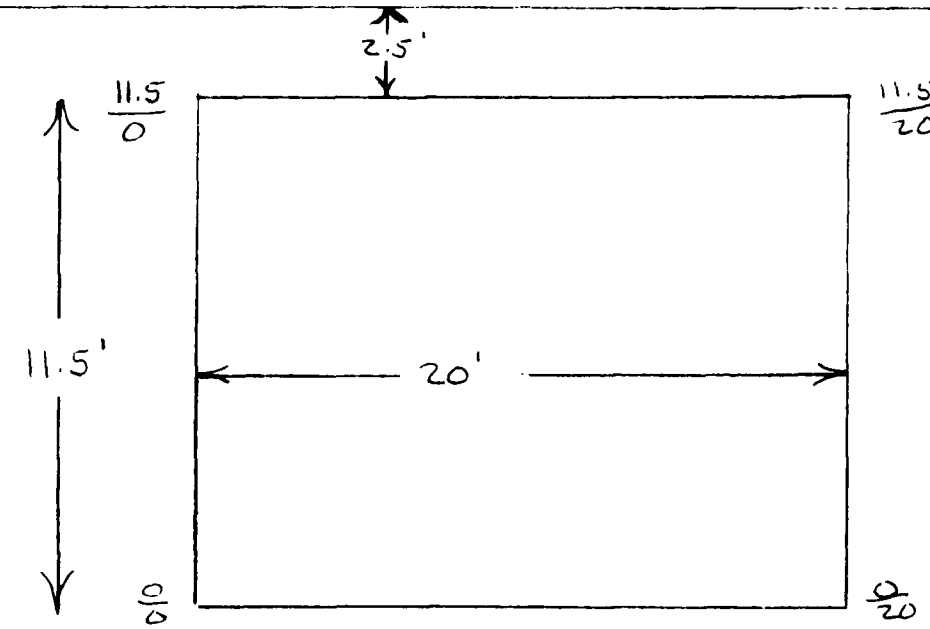
Depth	Elev.	Area	W.P.	Q
4.8		130.9	36.7	1504
5.2		141.7	37.5	1691
5.6		152.5	38.3	1884
6.0		163.6	39.1	2082
6.4		174.1	39.9	2285

Lake Anasaguntcook
Rating Curve - Footbridge 200' d/s of dam



SQUARES 1/4 IN. SCALE

Downstream Hazard. Route 108 approx. 500' d/s of dam



concrete side
cobbled bottom

n = .028

S = 0.010

length = 52'

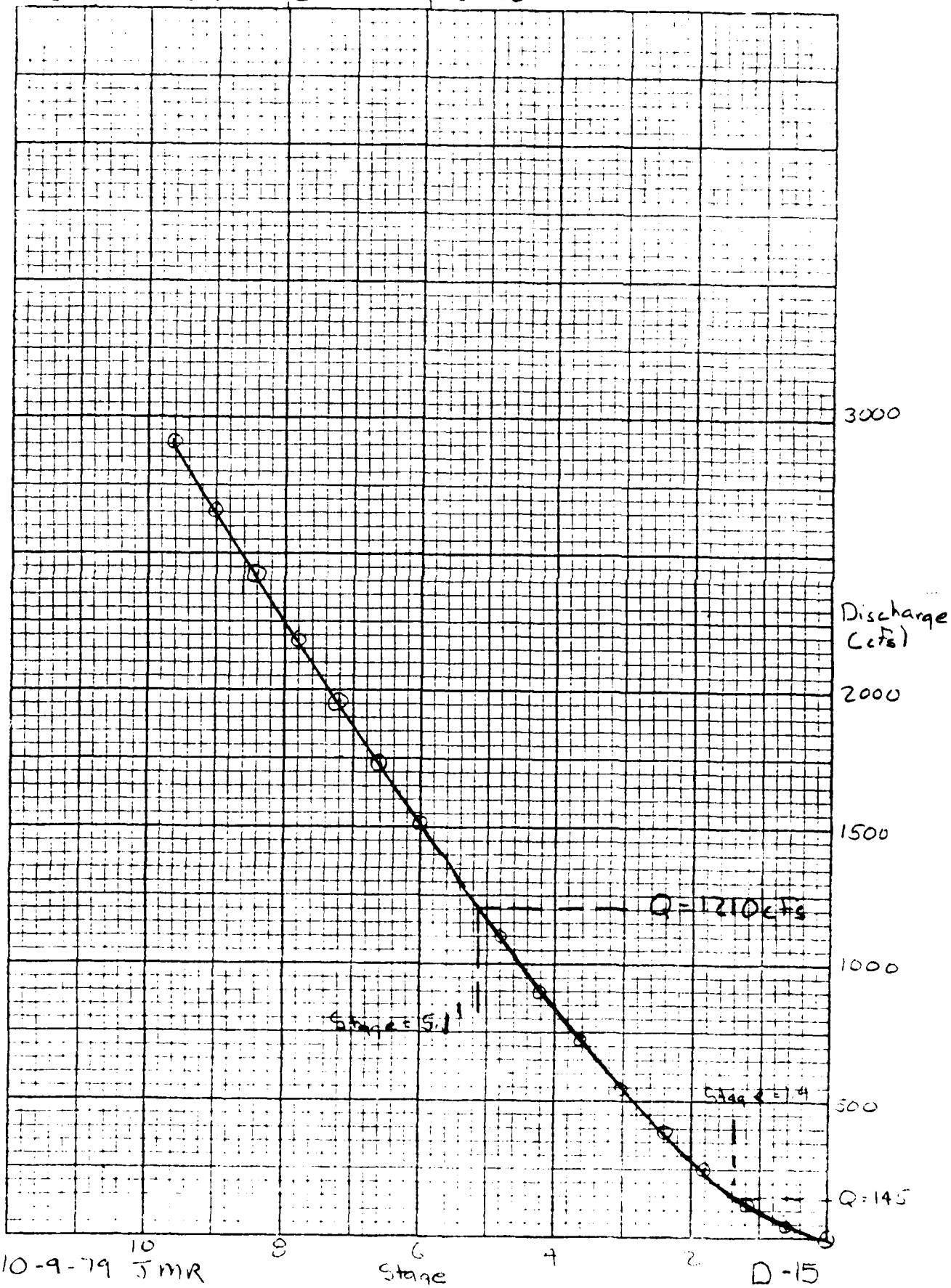
* Sill of Pete's Market is 7.7' above stream elev.

Depth	Area	W P	Q
0	0	0	0
0.6	11.5	21.2	40
1.2	23.5	22.4	129
1.8	35.5	23.6	247
2.4	47.5	24.8	388
3.0	59.5	26.0	547
3.6	71.5	27.2	720
4.2	83.5	28.4	906
4.8	95.5	29.6	1102
5.4	107.5	30.8	1306
6.0	119.5	32.0	1518
6.6	131.5	33.2	1737
7.2	143.5	34.4	1961
7.8	155.5	35.6	2191
8.4	167.5	36.8	2425
9.0	179.5	38.0	2663
9.6	191.5	39.2	2905

Lake Anasagunticook

Downstream Hazard - Route 108 approx. 500' d/s of Dam

Elevation - Discharge Rating Curve



10-9-79 JMR

D-15

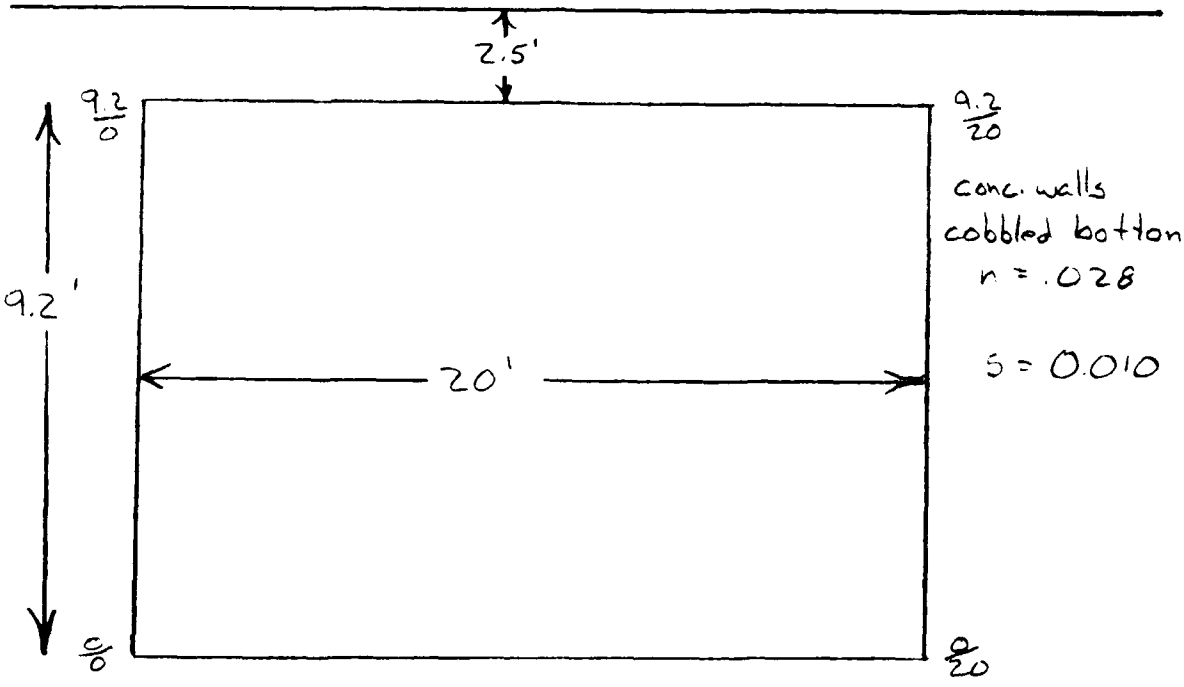
Anderson-Nichols & Company, Inc. Subject _____

Sheet No. 15 of 19
Date 10-9-79
Computed JMP
Checked _____

JOB NO. Lake Anasagunticook 3273-17

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Downstream - Route 140 approx 63' d/s of Route 108



conc. walls
cobbled bottom
n = .028

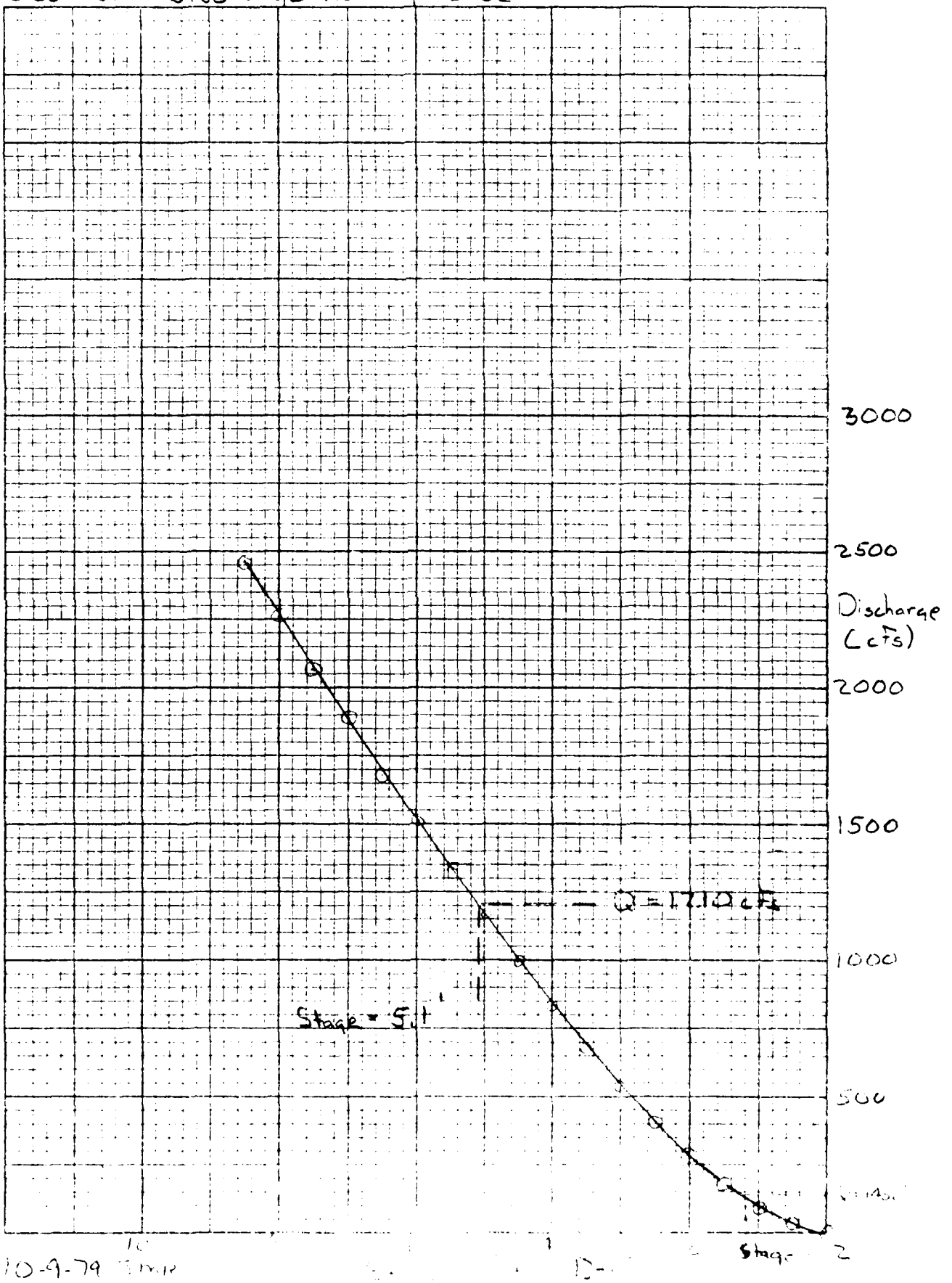
S = 0.010

Depth	Area	WP	Q
0	0	0	0
0.5	9.2	20.9	28
1.0	19.2	21.9	93
1.5	29.2	22.9	182
2.0	39.2	23.9	289
2.5	49.2	24.9	410
3.0	59.2	25.9	543
3.5	69.2	26.9	686
4.0	79.2	27.9	838
4.5	89.2	28.9	998
5.0	99.2	29.9	1164
5.5	109.2	30.9	1336
6.0	119.2	31.9	1513
6.5	129.2	32.9	1695
7.0	139.2	33.9	1880
7.5	149.2	34.9	2070
8.0	159.2	35.9	2263
8.5	169.2	36.9	2459

160 " 19

Lake Anasaguntacook
Downstream Hazard - Route 140 63' d/s of Route 108

Elevation - Discharge Rating Curve



10-9-79

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

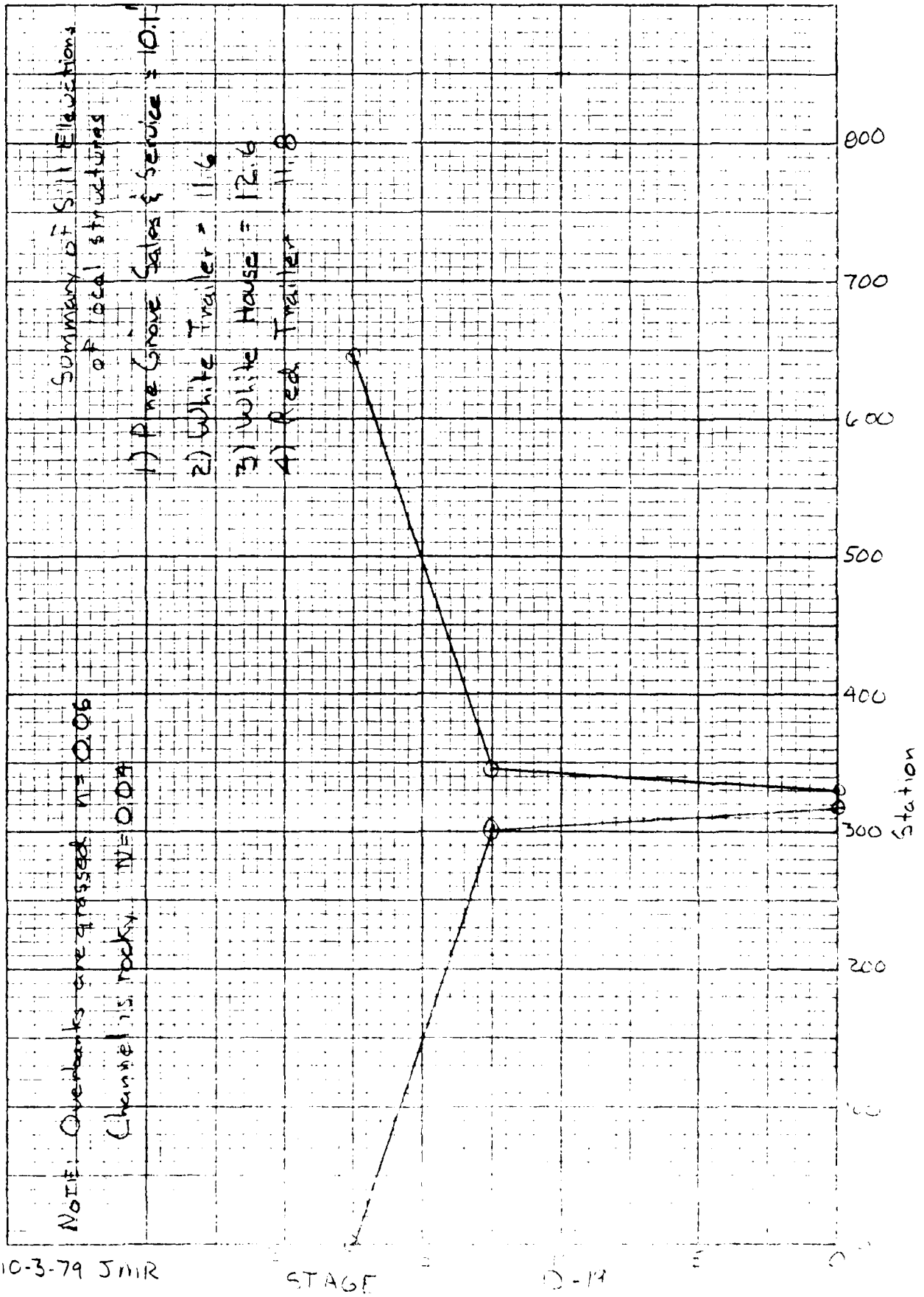
Rating Curve Data @ Typical x-section ≈ 500' downstream of Route 140

Data generated from computer program of Manning's Equation using the Commodore PET (2001 Series).

Depth	Elev.	Area	Wetted Perimeter	Q
C		C	C	C
0.9		14.0	17.7	44
1.8		50.4	20.5	146
2.7		48.7	23.1	294
3.6		69.0	26.2	486
4.5		91.2	29.0	723
5.4		115.3	31.8	1005
6.3		141.4	34.6	1333
7.2		169.4	37.4	1709
8.1		199.4	40.2	2135
9.0		231.3	43.0	2613
9.9		265.1	45.8	3144
10.8		300.9	48.7	3731
11.7		338.7	51.5	4374
12.6		378.7	63.0	4447
13.5		420.7	121.1	2974*
14.4		670.3	124.1	3705*
15.3		761.9	367.1	5377
16.2		1350.7	497.1	7890
17.1		1836.7	603.1	11022

slope = 0.010 (used) slope of channel from d/s end of Route 108 to d/s end of Route 140 bridge as computed from survey data.

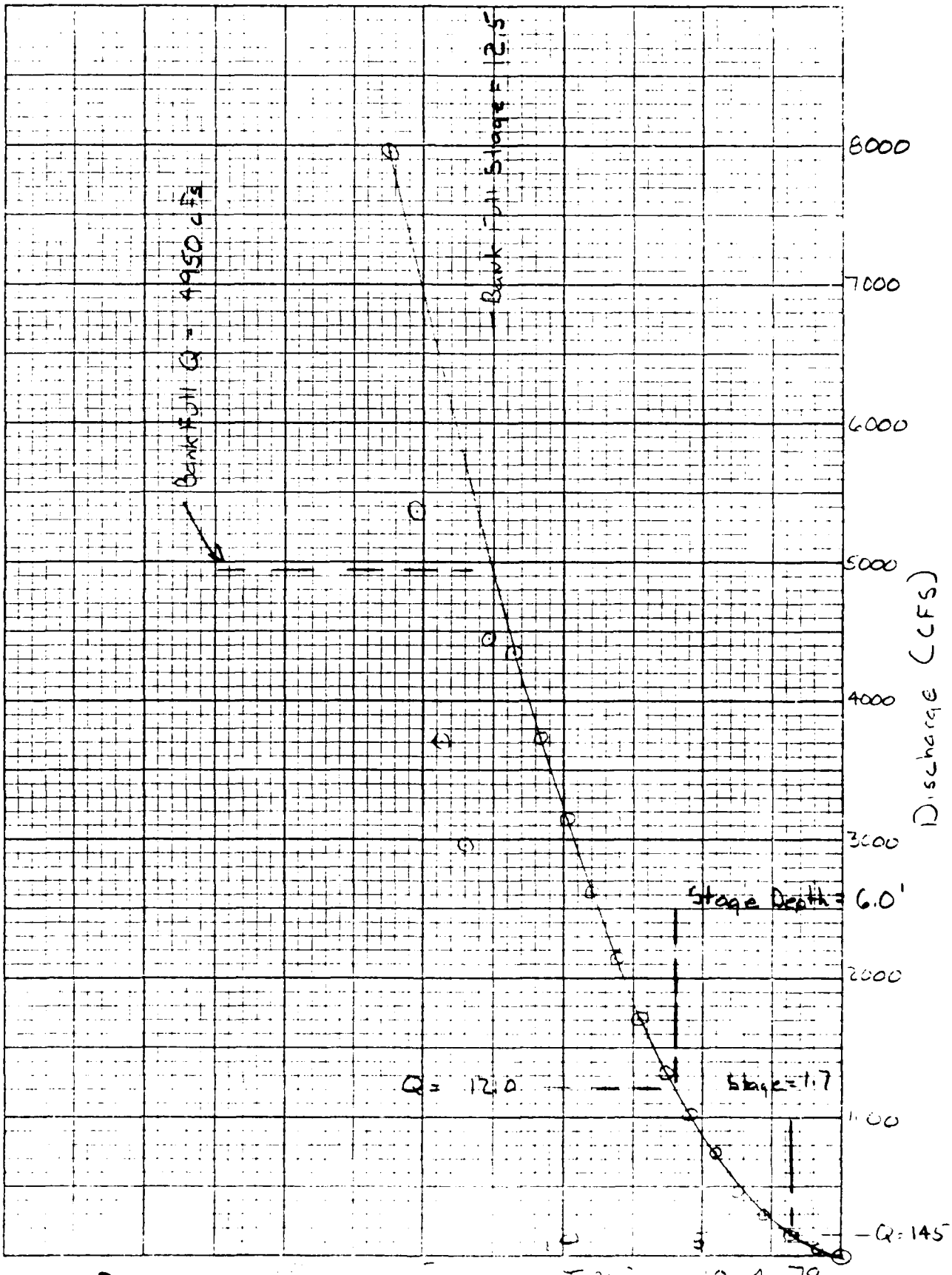
Lake Anasagunticook - Typical downstream x-section
located approximately 500' upstream of Route 140



10-3-79 JMR

Lake Anaconda Creek

Stage - Discharge for Downstream Hazard - 500' d/s of Rte 140



TEST FLOOD ANALYSIS

Drainage Area: 14.95 mi^2
Hazard Classification: Significant
Size Classification: Intermediate
Hydraulic Height = top of dam @ max. pool - d/s Invert
= 404.2 - 384.0 = 20.2'
Maximum Pool Storage @ top of dam (404.2) = 5800 ac.-Ft

Test Flood Range: ½ PMF - PMF
Chosen Test Flood: ½ PMF (provide loss of a few lives)

Step 1 Determine Peak Flow

Use "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, March, 1978" as a reference

a) Calculate Watershed Slope - Two major tributaries contribute to the Lake Anasagunticook drainage system. Slopes values for these two tributaries were calculated and then averaged to obtain the avg. watershed slope

Thompson Brook	Sparrow Brook
Distance - 3.9 miles	D = 4.44 miles
Relief = 1106 - 402 = 704'	R = 1061 - 402 = 659
Slope = 180.5 ft/mi	Slope = 148.4 ft/mi

Avg. Slope = $\frac{180.5 + 148.4}{2}$ = 164.4 ft/mi

b) Use the rolling curve of the "Maximum Probable Flood Peak Flow Rates"
D.A. = 14.95 mi^2
MPF in cfs/mi = 1530 cfs/mi^2
MPF = 22,875 cfs

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

TEST FLOOD ANALYSIS (CONT.)

Q_{P_1} = ½ PMF = 11,438 cfs → Elev. 408.3 → 7600 ac-ft

(obtained using Elevation - Discharge Rating Curve & Storage - Elevation Curve)

Surcharge Storage = 7600 - 4924 = 2676 ac-ft

STOR1 = 2676 ac-ft. = 116,566,560 ft^3 = 3.4" of runoff

D.A. = 14.95 mi^2

$$Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR1}{9.5}\right) \leftarrow \text{½ PMF runoff}$$

$$Q_{P_2} = 11{,}438 \left(1 - \frac{3.4}{9.5}\right) = 7344 \text{ cfs}$$

Q_{P_2} = 7344 cfs → Elev. 407.4 → 7200 ac-ft

STOR2 = 2276 ac-ft or 99,142,560 ft^3

STOR2 = 2.9" of runoff

$$\text{Avg Surcharge Storage} = \frac{STOR1 - STOR2}{2}$$

Avg. Surcharge Storage = 3.15" ≈ 3.2"

3.2" of runoff or 111,114,888 ft^3 or 2551 ac-ft

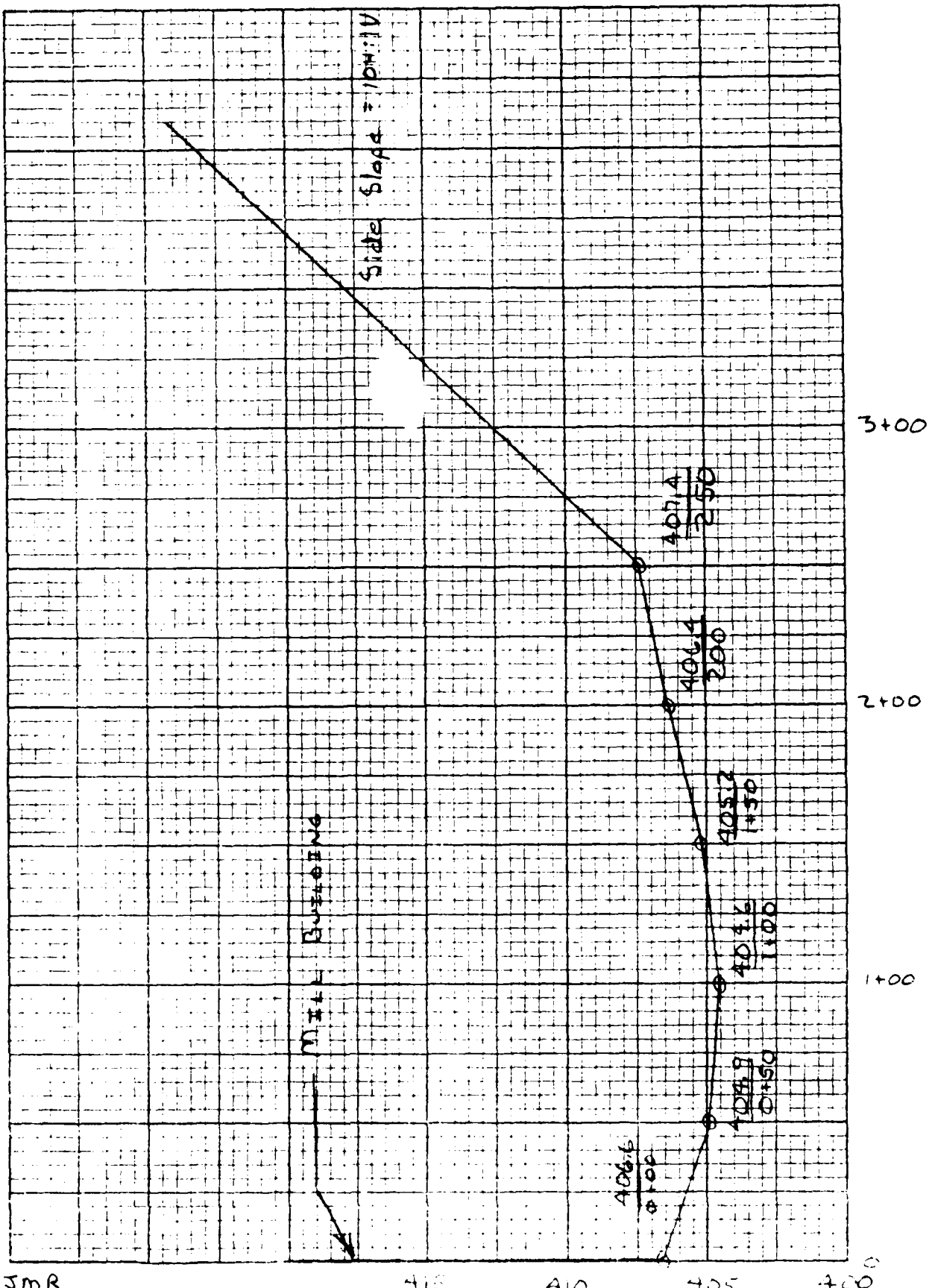
Total Storage = 2551 + 4924 = 7475 ac-ft

Q_{P_3} = 9900 cfs ← Elev. = 408.0

Surcharge Storage = 7200 - 4924 = 2276 ac-ft

Lake Anasagunticook

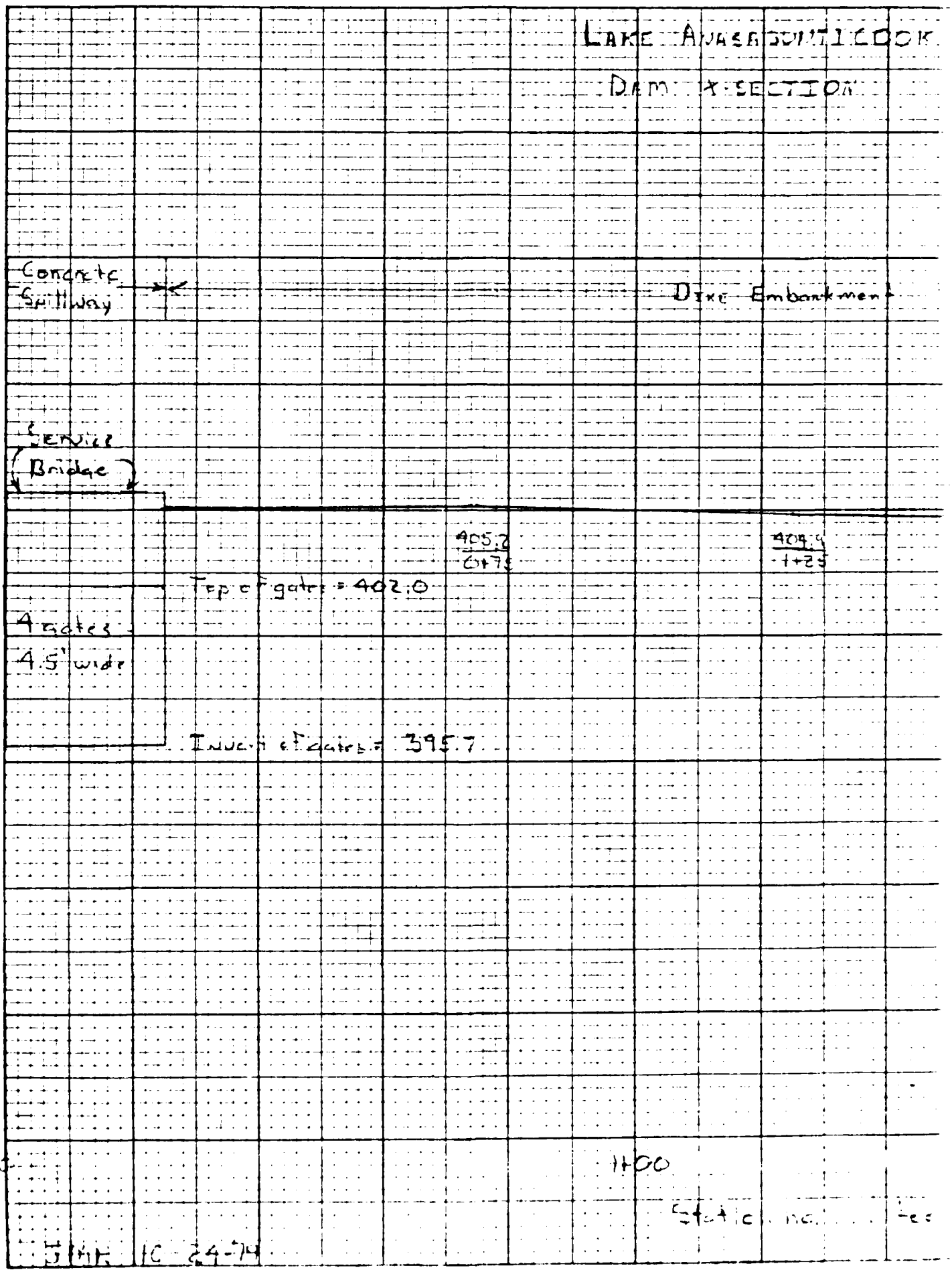
X-SECTION for Right Bank to Spillway, Approach Channel

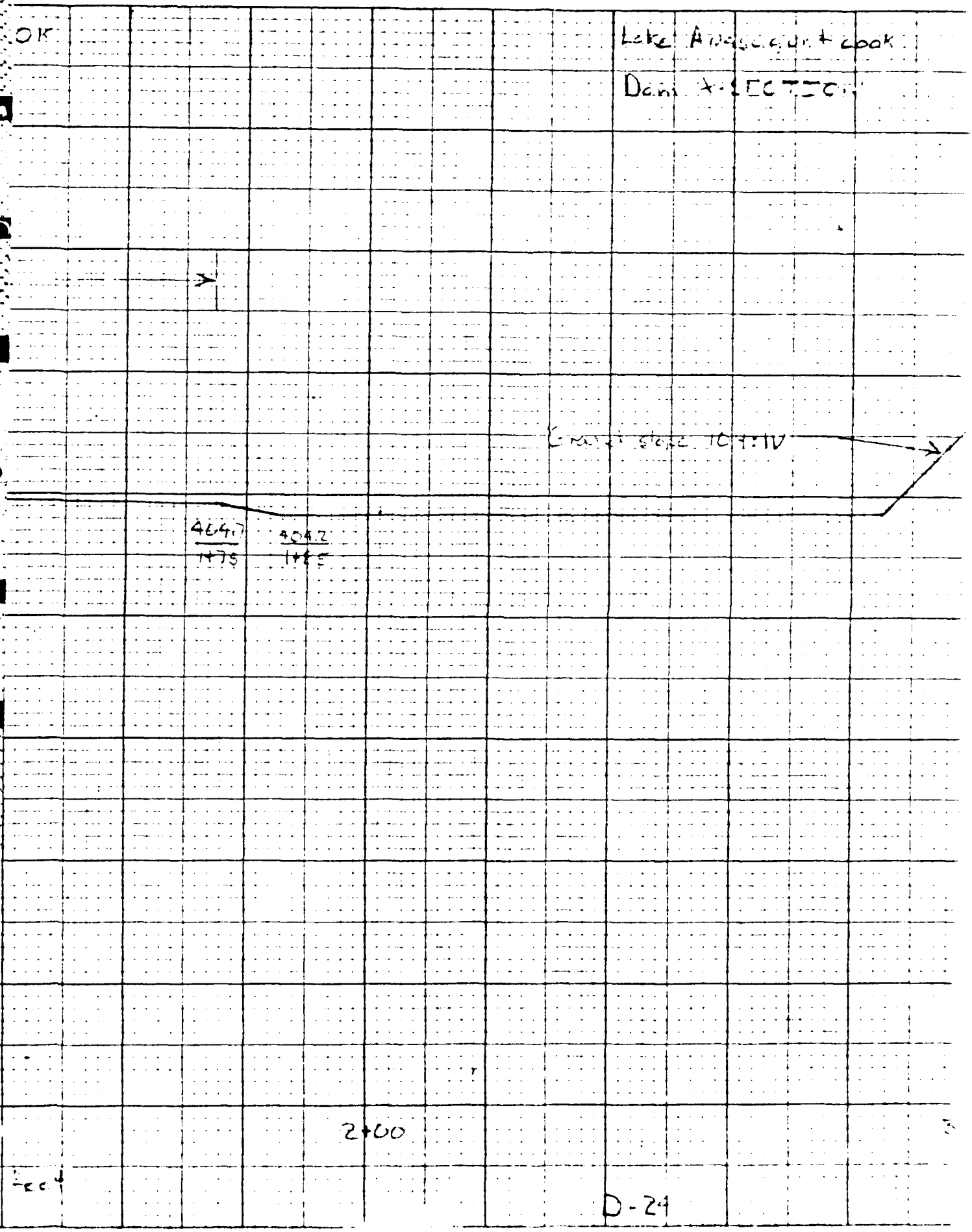


JMR
10-24-79

LAKE ANAHEAD UNIT I COOK

DAM X-SECTION

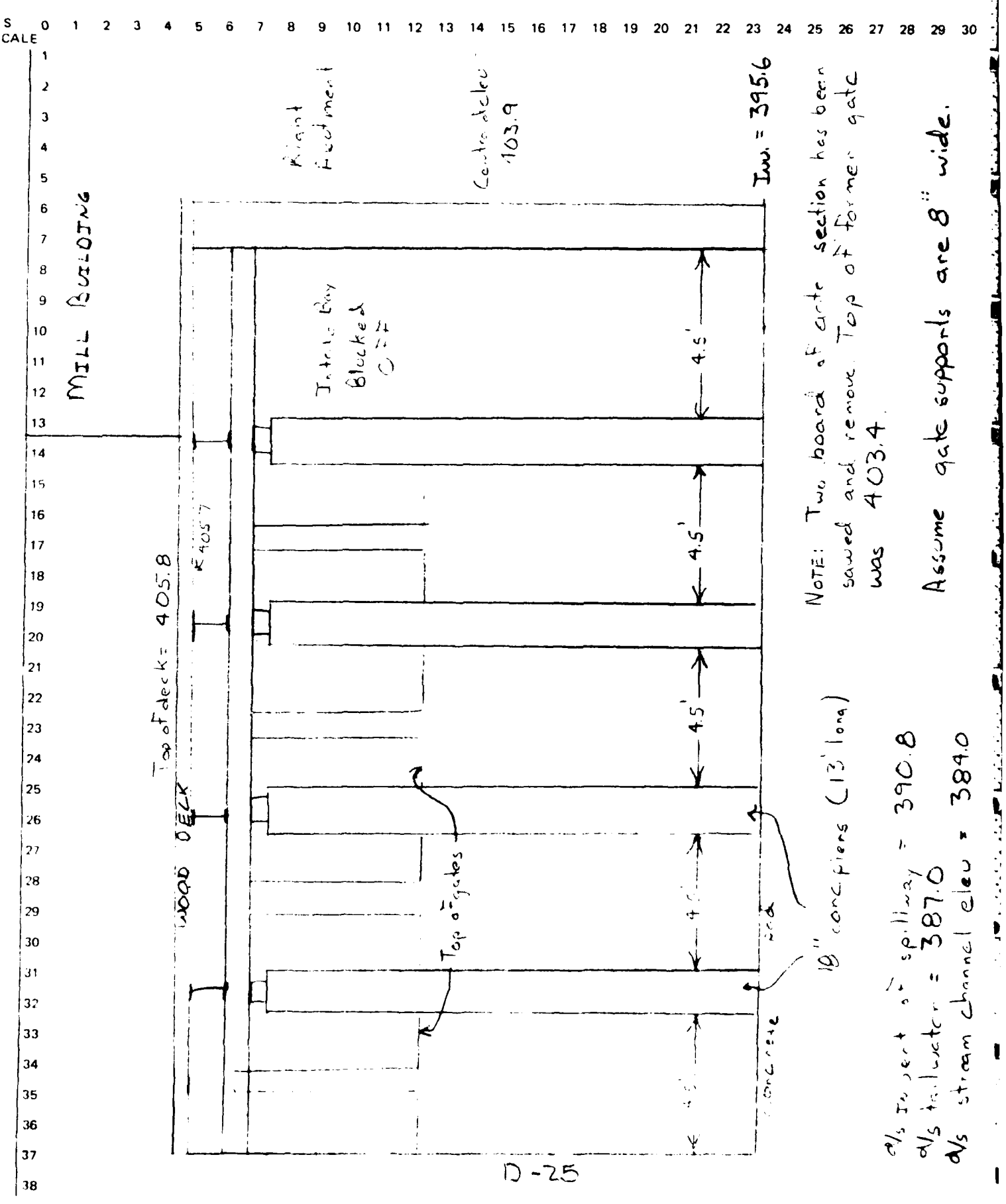




derson-Nichols & Company, Inc. Subject

JOB NO. Lake Nagog Spillway Dam - Canton MA

Sheet No. ____ of ____
Date 9-20-79
Computed SMR
Checked



SQUARES 1/4 IN. SCALE

Elevation-Discharge Rating Curve @ Spillway
Attachment "A"

Assumptions:

1) Assume concrete piers extend to wooden deck of walkway. This will simplify calculations and won't significantly affect the accuracy of the results

2) Assume weir acts like a sharp-crested weir and using Figure 5-2 in King and Brater Handbook of Hydraulics" use a value of C = 3.3

3) Effective length of weir = total width - width of one pier - width of two supports

$$L = 28.5 - 10.5 - 2.7 = 15.3'$$

4) Assume water surface elevation (i.e. elev. of top of weir = 1020)

WEIR EQUATION:

$$Q = C L H^{3/2}$$

Trial	Elev	H	Q
1	4020	0	0
2	4022.5	2.5	128
3	4024.0	4.0	300
4	4025.0	5.0	473
5	4026	6	713

Trial #6 Elev = 4025

NOTE left abutment wing wall to contain flow

$$Q_T = Q_{sp} + Q_L$$
$$= (3.3)(15.3)(2.5)^{3/2} + (2.6)(109)(3)^{3/2}$$
$$= 200 + 47$$
$$= 247 \text{ cfs}$$

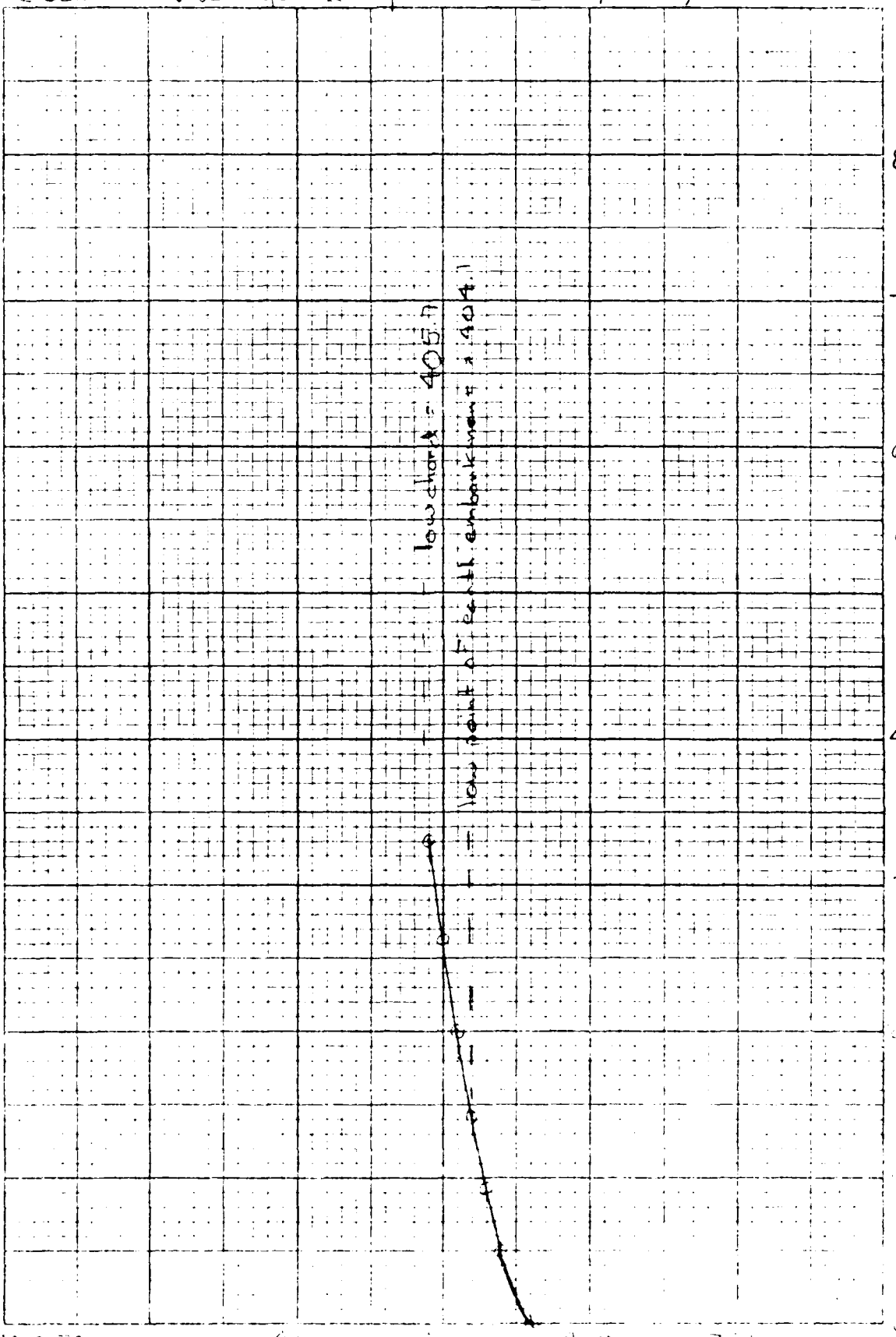
D-26

Attachment "A"

2 of 6

Lake Arrowhead Creek

Elevation - Discharge Rating Curve @ Spillway



10-9-79

JMR

D-77

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Elevation - Discharge Rating Curve (cont.)

@ Elevation 404 & Left abutment flow begins over earth embankment. There are total flow is equal to flow @ spillway plus weir flow over the earth embankment comprising the the left abutment in addition to flow over the right bank of the approach channel. Refer to the respective x-sections to obtain weir lengths, elevations.

Trial # 7 Elevation = 405.1

$Q = Q_{sp} + Q_{l} + Q_{r}$

Q_s = Flow over spillway
Q_l = Flow over left abutment
Q_r = Flow over right abutment

$Q = (2.3)(15.3)(3.1)^{3/2} + (2.6)(101)(0.9)^{3/2} + (2.6)(48)(.5)^{3/2}$
$Q = 276 + 224 + 44$
$Q = 544$ cfs

NOTE: Assumed $C = 2.6$ for left abutment and right bank

Trial # 8 Elevation = 406.1

NOTE: Pressure flow & weir flow occur @ spillway section

Used [illegible] pressure flow calcs.

$Q = A\sqrt{2gh}$

where A = Opening area of gates = $56 ft^2$
[illegible] gate opening
[illegible] Table 4-1 of
[illegible] Handbook of

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

ELEVATION - DISCHARGE RATING CURVE (CONT)

$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

Q_{SW} = weir flow over spillway section
Q_{SP} = pressure flow @ spillway section
Q_L = weir flow over left abutment
Q_R = weir flow over right bank

$Q = (2.6)(25)(.3)^{3/2} + (.8)(56.6)\sqrt{2(32.2)(2.2)} + (2.6)(139)(.9)^{3/2} + (2.6)(.88)(1.5)^{3/2}$

$Q = 11 + 539 + 946 + 420$

$Q = 1916$ cfs

Effective Weir length
$L_L = 50\%$
$L_R = 50\%$

Trial #9 Elev = 407.1

$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

$Q = (.6)(25)(1.3)^{3/2} + (.8)(56.6)\sqrt{2(32.2)(3.2)} + (.6)(284)(2.9)^{3/2} + (2.6)(118)(2.5)^{3/2}$

$Q = 96 + 650 + 3698 + 1213$

$Q = 5657$ cfs

$L_L = 100\%$
$L_R = 50\%$

Trial #10 Elev = 408.1

$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

$Q = (2.6)(25)(2.3)^{3/2} + (.8)(56.6)\sqrt{2(32.2)(4.2)} + (2.6)(298)(3.9)^{3/2} + (2.6)(195)(3.5)^{3/2}$

$Q = 227 + 745 + 5968 + 3320$

$L_L = 100\%$
$L_R = 50\%$

$Q = 10{,}260$ cfs

SQUARES 1 1 IN. SCALE

ELEVATION - DISCHARGE RATING CURVE (CONT.)

Trial # 11 Elev = 409.1

$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

$Q = (0.6)(25)(2.3)^{3/2} + (0.8)(56.6)\sqrt{2(32.2)(5.2)} + (2.6)(308)(4.9)^{3/2} + (2.6)(199)(4.5)^{3/2}$

$Q = 310 + 8[illegible] + 8686 + 4939$

$Q = 14,844$

$L_L = 100\%$
$L_R = 75\%$

Trial # 12 Elev = 410.6

$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

$Q = (0.6)(25)(3.8)^{3/2} + (0.8)(56.6)\sqrt{2(32.2)(6.7)} + (2.6)(328)(6.4)^{3/2} + (2.6)(210)(6.0)^{3/2}$

$Q = 481 + 940 + 13597 + 8025$

$Q = 23,043$ cfs

$L_L = 100\%$
$L_W = 75\%$

Trial # 13 Elev = 411.6

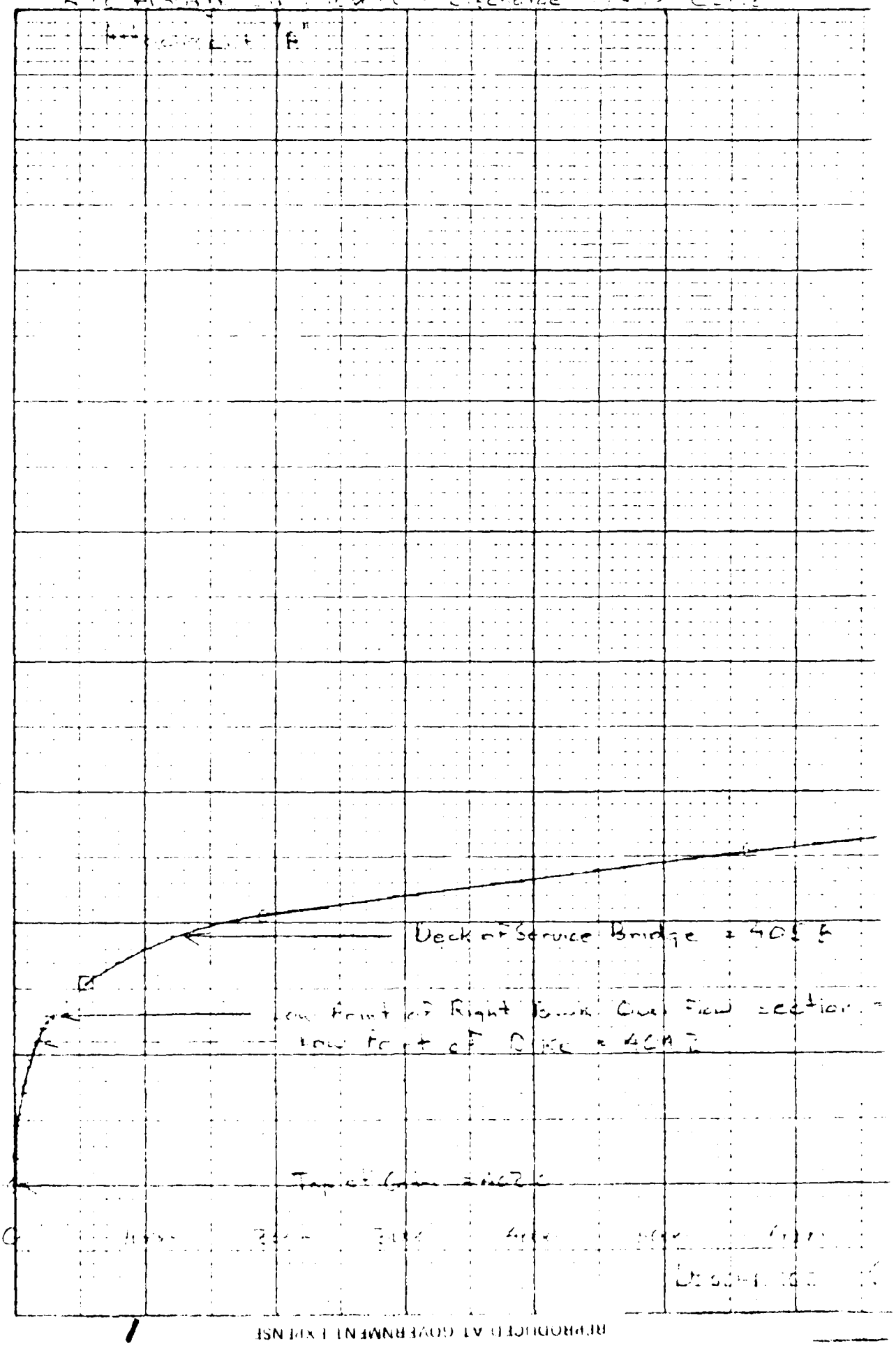
$Q = Q_{SW} + Q_{SP} + Q_L + Q_R$

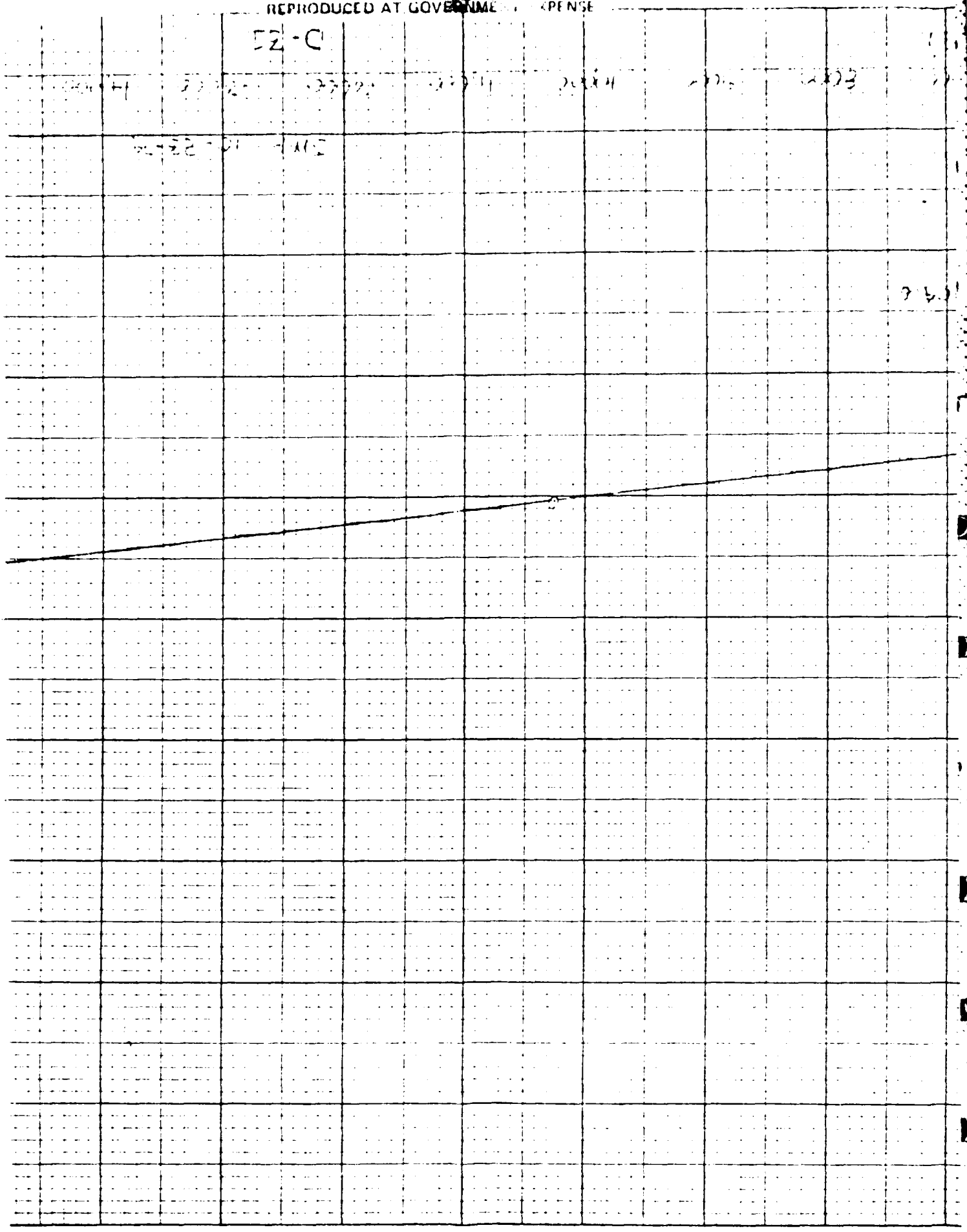
$Q = (0.6)(25)(4.8)^{3/2} + (0.8)(56.6)\sqrt{2(32.2)(7.7)} + (2.6)(323)(7.4)^{3/2} + (2.6)(218)(7.0)^{3/2}$

$Q = 684 + 1008 + 17439 + 10497$

$Q = 29,618$ cfs

$L_L = 100\%$
$L_R = 75\%$


Deck of Service Bridge = 405.5
Top of Gate = 402.5



SQUARES 1/4 IN. SCALE

Storage vs Elev - Calculations - Attachment "B"

- Normal Pool Elevation = 402' MSL
  Surface Area @ Normal pool elev. (402) = 582.4 acres

- Assumed invert of pool elev. = 15' below normal pool elev.
  ∴ Invert of pool = 387 MSL
  @ Elev = 387 MSL storage = 0 acre-ft

- @ Elev = 420 MSL surface area = 896 acres

Use formula for volume of frustrum of a pyramid to calculate storage.

$$V = \frac{1}{3} H\left[(B_1 + B_2) + \sqrt{B_1 + B_2}\right]$$

B_1 = lower base
B_2 = upper base
H = elev. difference between bases

Trial # 1 Elev = 387

V_1 = 0 acre-ft

Trial # 2 Elev = 402

B_1 = 372 acres
B_2 = 582.4
H = 15

$$V_2 = \frac{1}{3}(15)\left[(372 + 582.4) + \sqrt{372 + 582}\right]$$

V_2 = 4924 acre-ft
V_T = 4924 acre-ft

SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Storage vs Elevation - Calculations (cont)

Trial #3 Elevation = 420

A_1 = 582 acres

A_2 = 896 acres

H = 18'

V_3 = volume of frustum between elevs. 402 & 420

V_T = total volume ($V_3 + V_2$)

$$V_3 = (18) \frac{1}{3} \left[(896 + 582) + \sqrt{896 \cdot 582} \right]$$

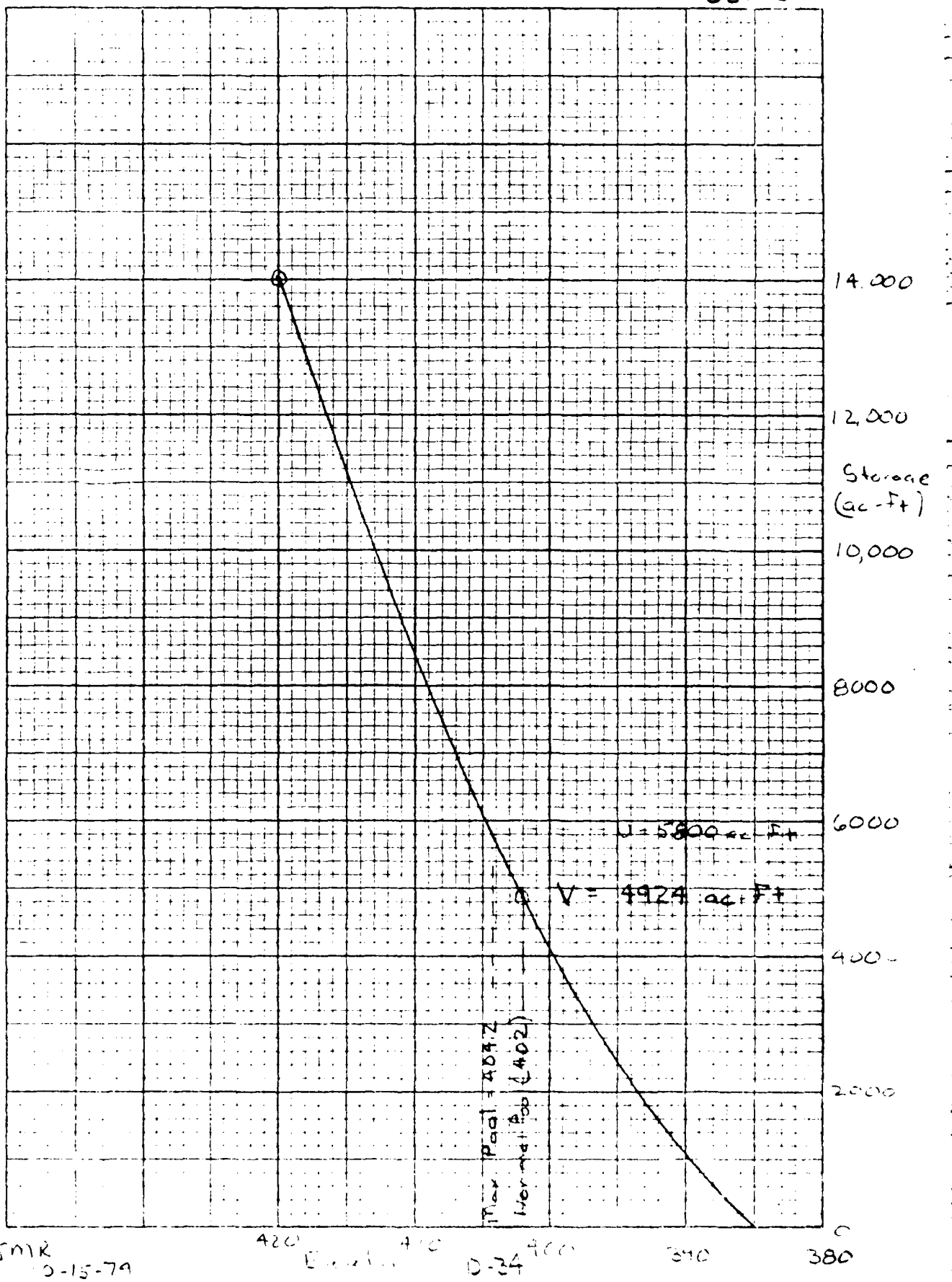
V_3 = 9099 ac-ft

V_T = 4924 + 9099 = 14,023 ac-ft

Lake Anasinguntacook
Storage vs Elevation

Attachment "B"

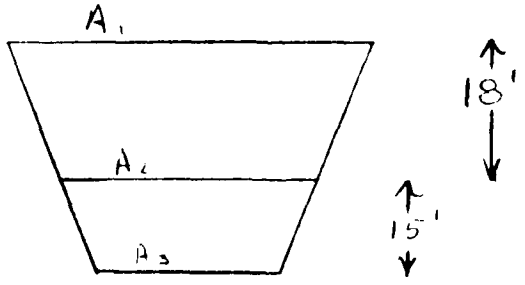
3 of 5



SQUARES 1/4 IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Sfc Area @ pond invert Elev = 387

Assume a circular surface area shape as the elevation changes.



Pool @ 420'

Normal Pool = 402

Pond Invert = 387

A_1 = 896 acres (39,029,760 ft²)
d_1 = 7049'

$A = \frac{\pi d^2}{4}$

A_2 = 582 acres (25,351,920 ft²)
d_2 = 5681' Elev = 402.0

Use a ratio to obtain A_3 (assume constant side slopes)

$A_3 = \pi\left(\frac{d_3}{2}\right)^2$

$$\frac{18}{7049 - 5681} = \frac{15}{5681 - d_3}$$

$$5681 - d_3 = \frac{1368\,(15)}{18}$$

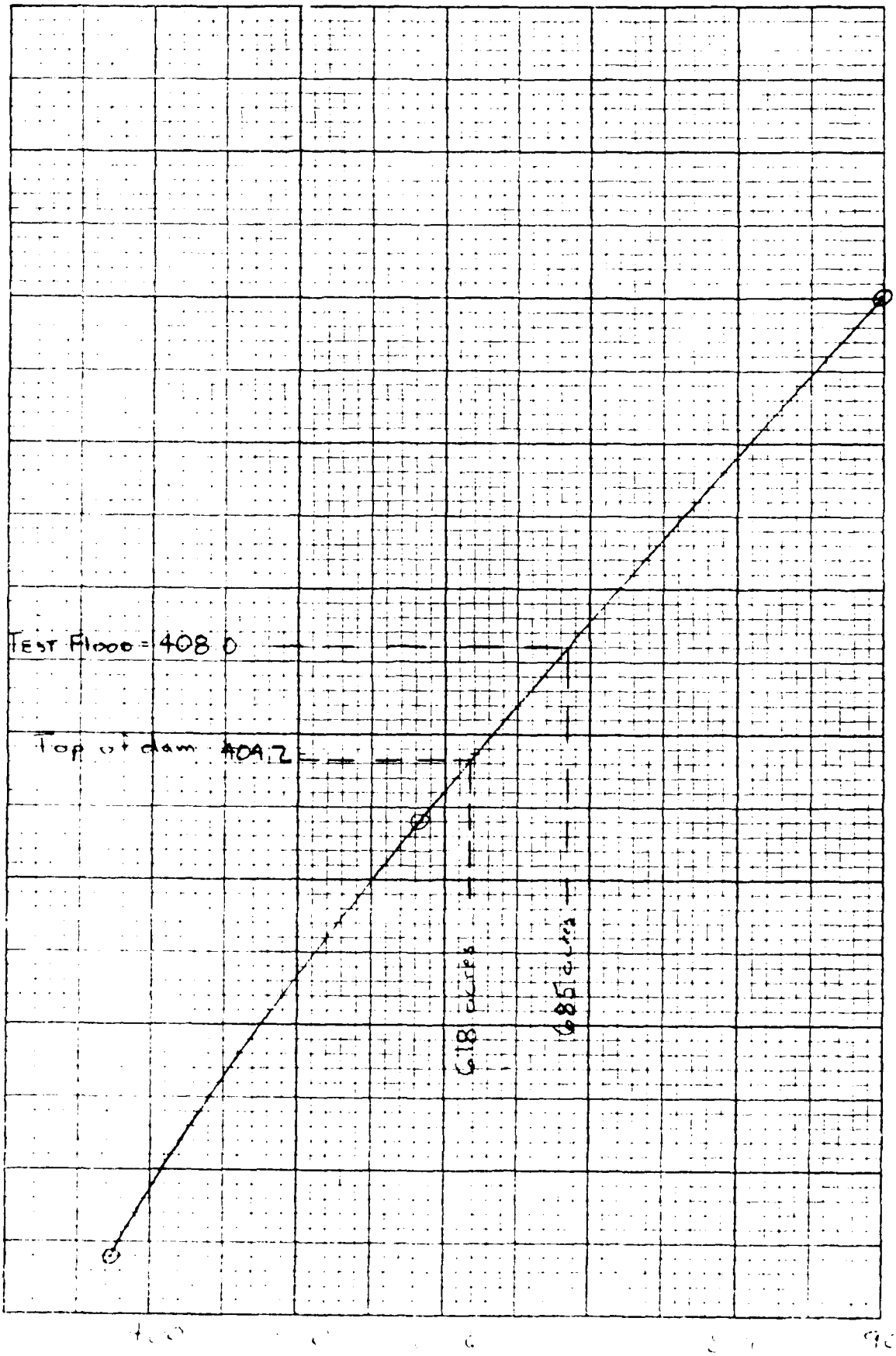
$$5681 - \frac{1368(15)}{18} = d_3$$

$$4541 = d_3$$

$A_3 = \pi\left(\frac{d_3}{2}\right)^2$

A_3 = 6 . 4 ft² or 371.8 acres

Lake Anna - Surface Area



Reservoir Area

D-36

SQUARES 1/4 IN. SCALE

GATE CAPACITY @ Top of Dam (404.2)

Assumptions:

1) All four gates invert raised to elevation = 404.2 (each gate 4.5' wide). ∴ pressure flow

2) Discharge capacity calculated using orifice equation

$$Q = CA\sqrt{2gh}$$

where C = orifice coefficient
A = orifice area
g = acceleration due to gravity
h = head to center of opening

3) Gates discharging freely into air.

Calculations

Area Each gate = $4.5' \times (404.2 - 395.6)$
$= 38.7\ Ft^2$
Total Area = $38.7 \times 4 = 154.8\ Ft^2$

Head

$$H = \frac{404.2 - 395.6}{2} = 4.3'$$

Coefficient

C = 0.7 (taken from King and Brater Table 4-9)

SQUARES 1/4 IN. SCALE

GATE CAPACITY (cont)

$$Q = (0.8)(154.8)\sqrt{(2)(32.2)(4.3)}$$

$$Q = 1803 \text{ c's}$$

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

8-85

DTIC